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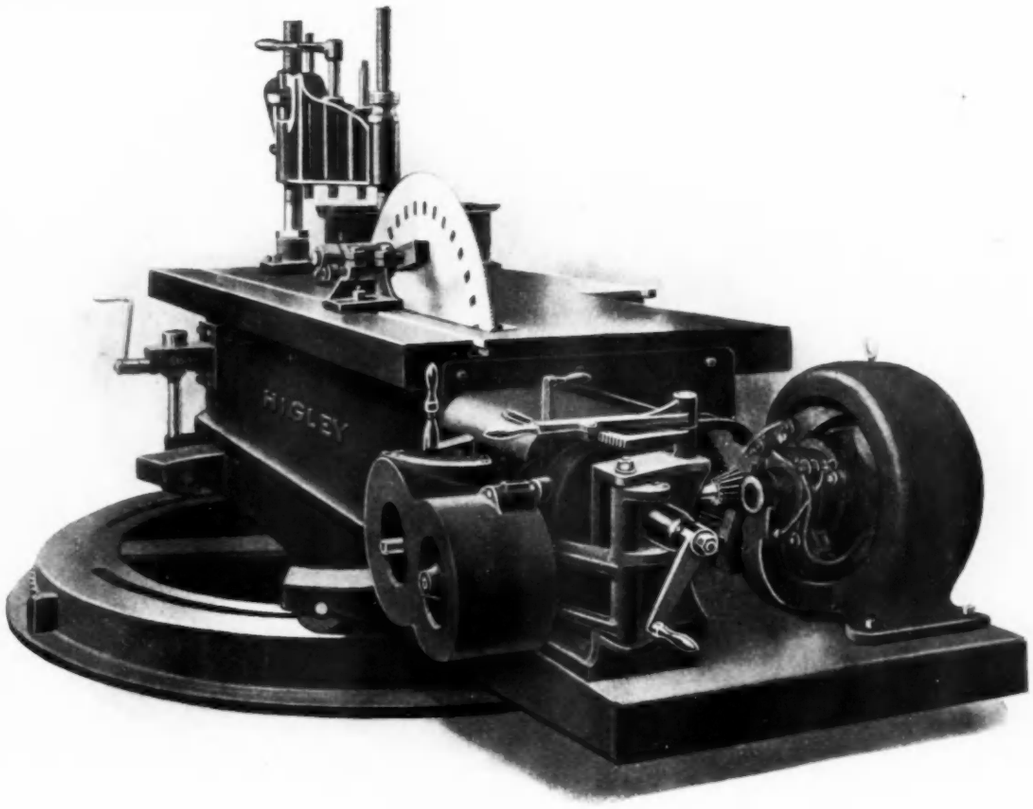

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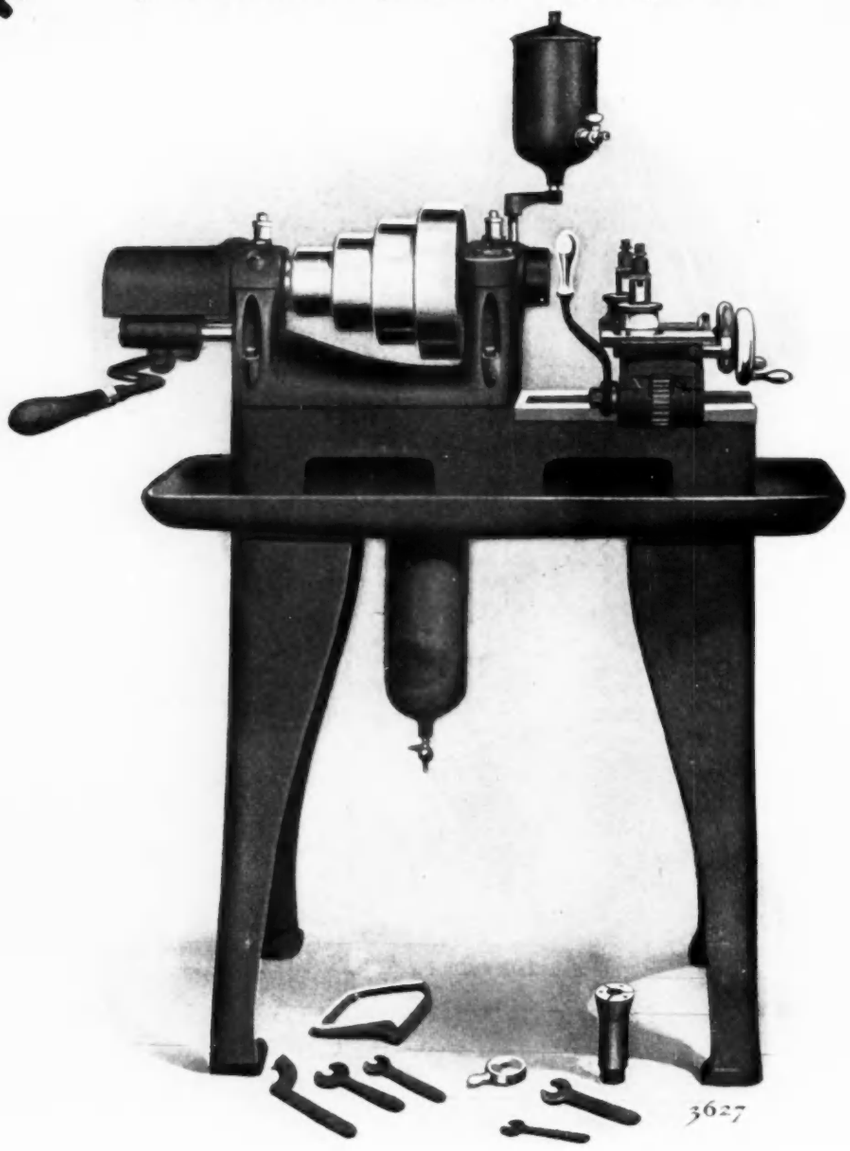

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Wright Aeroplane—A Noteworthy Invention

It Has Flown for Over an Hour in a 10-mile Breeze, Has Attained a Hight of 300 Feet and a Speed of Nearly 50 Miles per Hour

BY L. P. ALFORD

The results of the aëroplane trials that were conducted from September 3 to 17, inclusive, by Orville Wright at Fort Meyer, Virginia, in the presence of officers of the Signal Corps of the United States army, aroused great interest throughout the civilized world. They were surely epoch-making, and it is lamentable that they were brought to an end by disaster. A characterization of the machine as the greatest purely mechanical invention of this generation is none too strong.

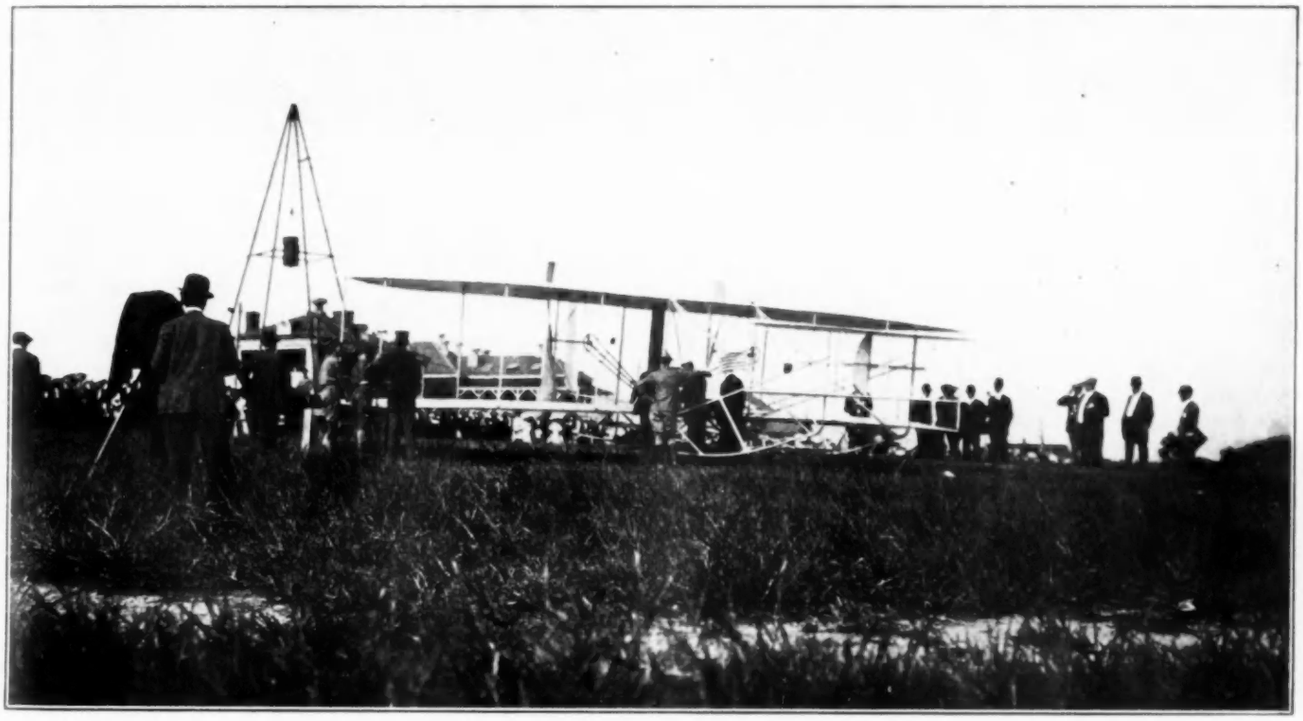


FIG. 1. THE WRIGHT AEROPLANE IN A POSITION TO BEGIN A FLIGHT

The accompanying half-tone illustrations show the aëroplane in position for starting a flight, Fig. 1 its general details and construction, Figs. 2 to 5, inclusive; its engine, propellers and transmission machinery, Figs. 6 and 7; and in actual flight, Figs. 8 and 9.

The Army Specifications

This machine was built to comply with a specification issued by the War Department for a heavier-than-air flying machine. A few of the more important provisions of this specification are: The construction of the flying machine must be such that it will be supported entirely by the dynamic reaction of the atmosphere and without any gas bag. It must be capable of being disassembled readily for transportation by army wagons. It must be capable of being assembled readily for flight in one hour. It must carry two passengers having a combined weight of 350 pounds, and a sufficient supply of fuel for a flight of 125 miles. Its speed in still air must be 40 miles per hour, and for that speed it will be paid for at the rate of 100 per cent. of the tender price.

A 10 per cent. reduction will be made for each mile less than the 40 miles per hour specified. However, any machine will be rejected that does not attain a speed of at least 36 miles per hour. Again a bonus of 10 per cent. will be paid for each mile in excess of the specified 40 miles per hour. During the trials the machine must be continuously in the air for one hour without landing. It must return and land at the starting place and be ready for another flight at once. The machine must be capable of being steered in all directions and must be at all times under perfect control. The starting device must be of such a nature that it can be easily transported in army wagons. If at any time the propelling power is rendered inoperative, the machine must return to the ground without injury to itself or any of its mechanism. It must be capable of landing in any open country without having a special landing place prepared for it.

The Aeroplane

The four general views, Figs. 2-5, inclusive, show the Wright aëroplane from front, rear and each end. Its general outlines are well known from illustrations that have appeared in the daily press and popular magazines. It consists of two long parallel planes that carry the machinery and operator. In front are two small horizontal rudder planes, and in the rear are two vertical rudder planes. It weighs complete about 850 pounds.

The large planes are some 40 feet in length, some seven feet wide and spaced about six feet apart. They are constructed of a light framework of white spruce, covered with a good quality of white muslin. The struts between the planes are of wood, and the trussing is by means of wire. The front of each plane is rigid. Similarly, the middle third of the back of each plane is also rigid. This result is obtained by means of the trussing. The end thirds of both planes at the rear are hinged to the middle third and are under control of one of the operating levers. The motion is such that as one

FIG. 2. THE FRONT OF THE WRIGHT AEROPLANE

end of both planes is thrown downward, the other end is thrown upward. This movement is made use of in balancing and in turning in the air.

The pair of small front-rudder planes, shown best by Figs. 2 and 5, are pivoted along a horizontal shaft that is supported and braced by the framework extending forward from the main planes. These rudder planes are spaced by wooden struts and are trussed together by means of wires, as the illustrations show. They are operated in unison by a long lever from one of the operating handles, rotating around a horizontal axis. The small D-shaped vane between these two planes has a dampening effect when the machine turns, or tends to turn, sidewise; in this way it adds to its stability.

At the rear is a pair of vertical rudders, best shown in Figs. 3 and 4. Its method of support and attachment is plainly shown. An operating handle controls its motion about a vertical axis, and its use is to turn sidewise in flight. The entire machine is mounted on runners resembling sleigh runners, and best shown by Fig. 4.

The wood used throughout is clear, white spruce, selected because of its lightness, strength and resilience. In finish the wooden parts are painted with aluminum paint; the cloth covering is left untouched and is, therefore, its natural

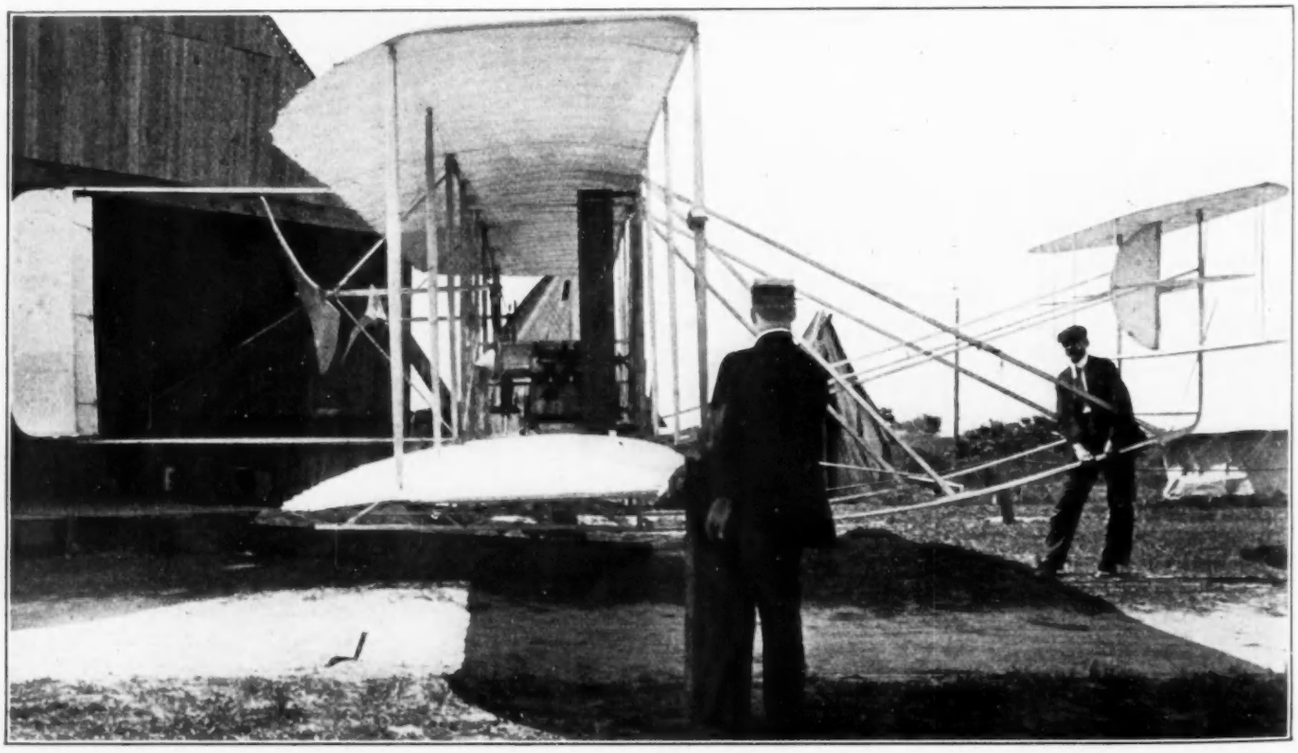


FIG. 3. THE RIGHT-HAND END OF THE WRIGHT AEROPLANE

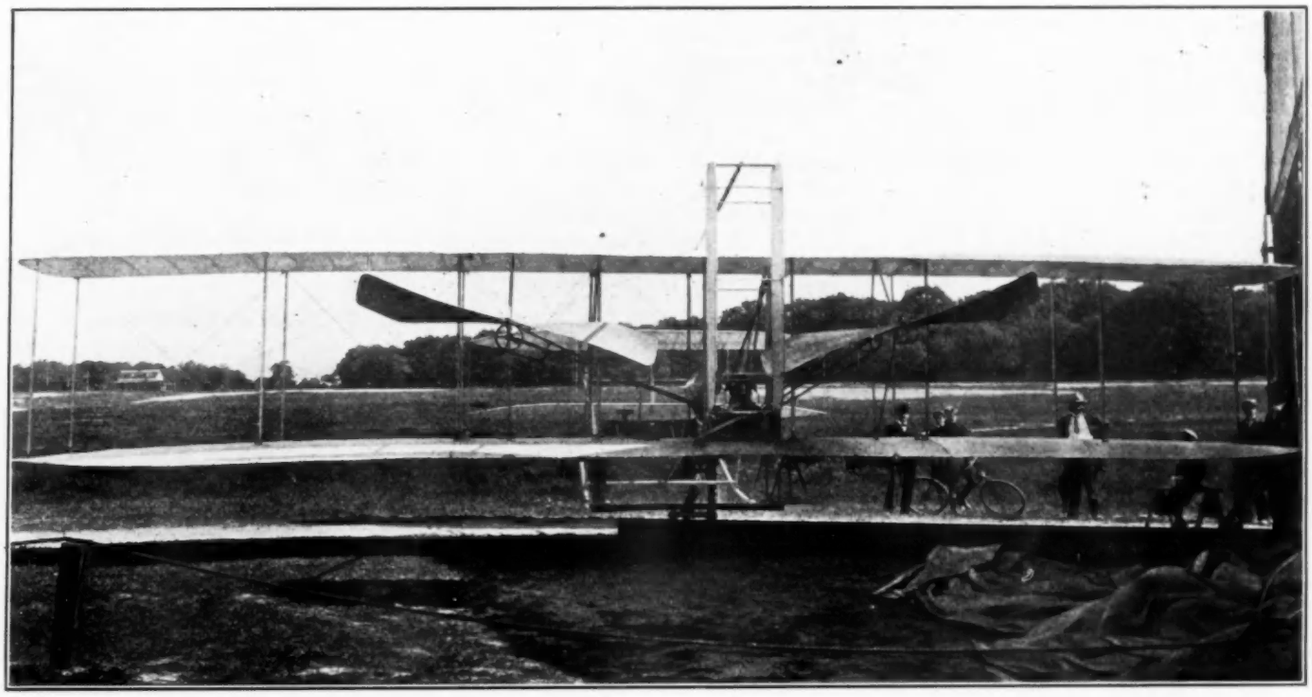


FIG. 4. THE REAR OF THE WRIGHT AEROPLANE

white. The surface of the parts of the machinery is so small in proportion to the area of the planes that the general white effect of the entire machine is in no way disturbed.

The Propelling Mechanism

The propelling and transmission machinery is shown by illustrations Figs. 6 and 7. The propellers themselves can be best seen in Fig. 4.

The engine is a four-cylinder two-cycle gasolene engine, designed and built by the Wright brothers. It weighs 170 pounds and develops from 25 to 30 horsepower. It is provided with a large storage tank, placed near the operator, has an Apple magneto and a special mixing valve instead of a carbureter.

A four-section radiator occupies the entire hight between the two main planes. This is composed of flattened brass tubing, connected into suitable headers at top and bottom. The piping to and from this radiator, together with the pump and magneto are best seen in Fig. 6.

The power is transmitted from the engine shaft to the propeller shafts by means of automobile chains. The ratio of speed reduction is 9 to 32. At this point is one of the most interesting mechanical devices of the entire machine: the crossed chain connecting the right-hand propeller with the engine. The chain is carried through guide tubes and we are informed works with perfect success.

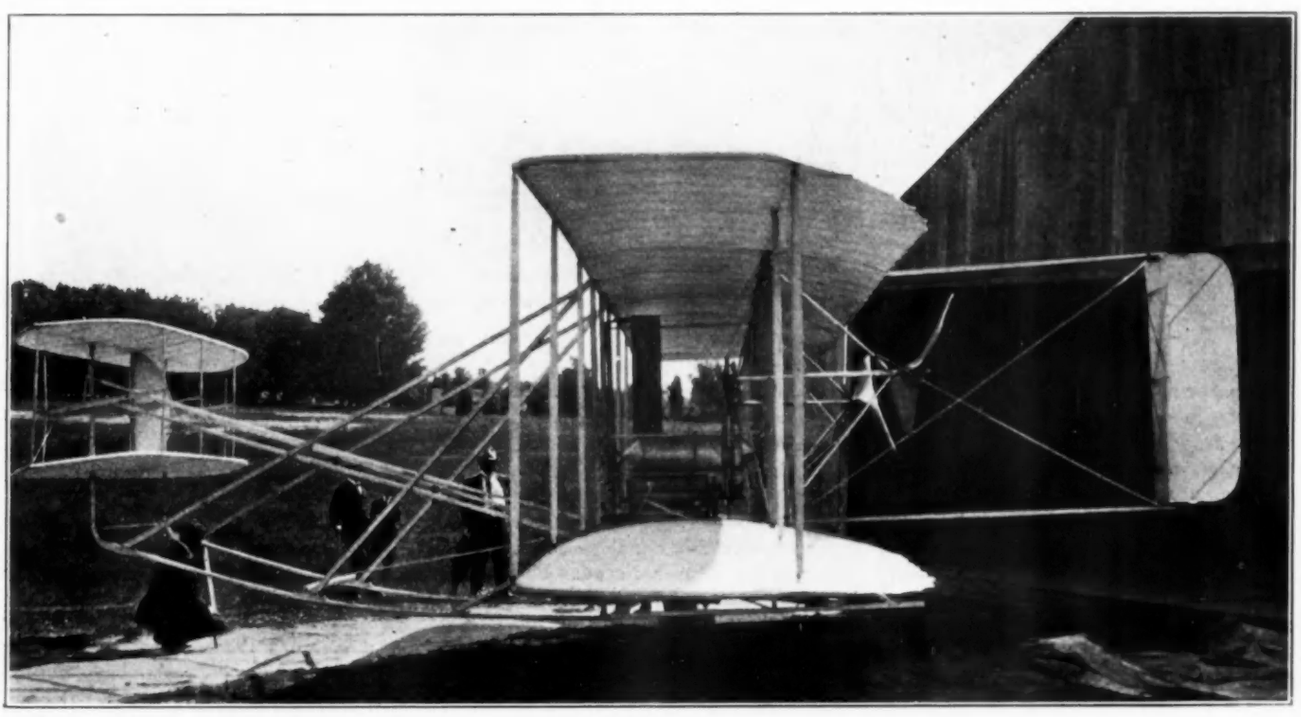


FIG. 5. LEFT-HAND END OF THE WRIGHT AEROPLANE

The details are shown at the left of Fig. 7.

The propellers are 8½ feet long, broad and square at the tips, are shaped to peculiar curved surfaces and revolve in opposite directions. They are carried on long shafts supported by metal braces, and these braces are practically the only metal braces used in the construction of the aëroplane. The speed of these propellers is from 350 to 400 revolutions per minute.

The Method of Starting

The method used to start this aëroplane is of particular interest. Fig. 1 shows the machine in position on its starting track and in front of the tower that forms part of the starting apparatus. The track is made of 1½x6-inch planks, carried edgewise on posts set in the ground. On the upper edge of this wooden track is a strip of 1x⅛-inch flat steel running its entire length. The length of the track is about 75 feet. The aëroplane is mounted on a swiveling tandem truck, which is well shown in Fig. 4. In that view the track upon which the machine is located is the track at the entrance to the temporary building used to shelter the machine during the Fort Meyer trials.

A weight of some 1300 pounds, composed of cast-iron disks is raised to the top of the starting tower. A rope runs from this weight around a pulley at the base of the tower, then to the front of the track around a second pulley, and back to the aëroplane. The propellers are set in motion, the operator takes his seat, the machine is balanced by attendants, and when everything is ready the operator slips a retaining cable, and the machine starts forward on the rail under the impulse given it by the falling weight. Before reaching the end of the track it lifts in the air and is in full flight.

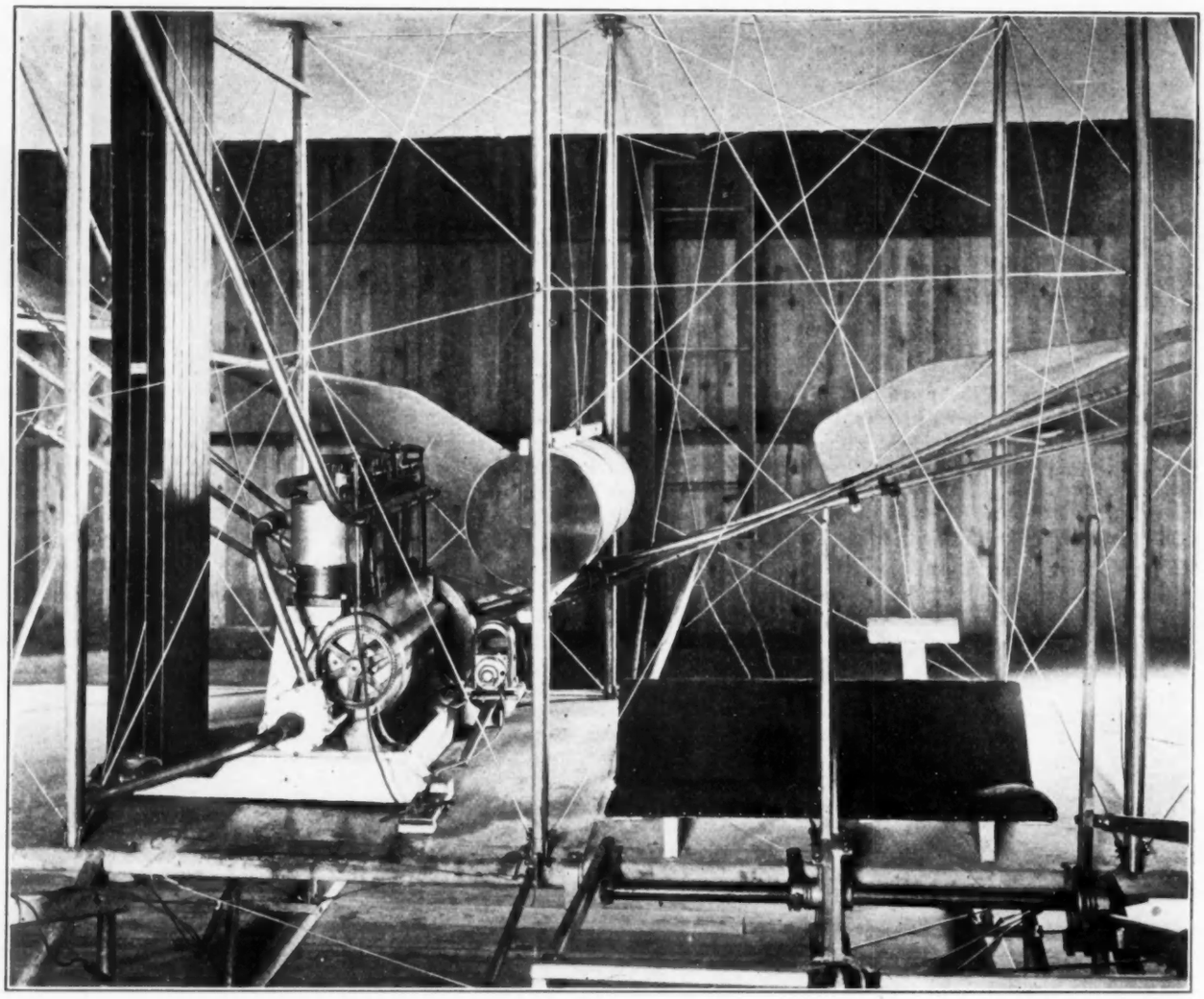


FIG. 6. THE POWER PLANT AND OPERATING LEVERS FROM THE FRONT

Control of the Machine

Three operating handles can be seen in front of the seat in Fig. 6. The seat is arranged to accommodate two persons. The operator sits at the right, or farthest from the engine. In that position his weight practically balances the weight of the engine. The second person sits on the midline of the machine and therefore automatically preserves the balance, whatever his weight may be.

Of the three operating levers, the one at the right of the illustration is connected with the front pair of rudder planes. These planes are used in controlling the vertical movements of the aëroplane. Of the other two handles, the one nearer the engine controls the swinging of the vertical rear rudders and its mate the twisting of the ends of the main planes. These two levers are placed back to back, as they are ordinarily worked together; although it is perfectly possible to separate them and work them independently, as indicated by the position that they occupy in the illustration.

Record Flights

The records of human achievement are shortlived at best, and this is peculiarly true of the first successful developments in any field. At the time of this writing, Mr. Wright's records established on September 10 and 12 stand as world's records for flight with heavier-than-air machines, although it is perfectly possible

that these records may be far surpassed by the time this article is printed.

On September 10, Orville Wright flew 58 times around the field at Fort Meyer in a breeze having a velocity of 10 miles per hour and blowing south by west. The total distance was 52.2 miles. The elapsed time from start to landing was 1 hour, 5 minutes and 52 seconds. The maximum hight attained was 200 feet. The engine was running a total of 1 hour, 6 minutes and 50 seconds. This record for distance and time is especially noteworthy because of the velocity of the wind.

On September 12, records were established for time, speed and hight. A measured mile was flown in 1 minute and 20 seconds, or at a speed of 45 miles per hour. The track was circled 71 times, or a distance of 63.9 miles. The elapsed time was 1 hour, 14 minutes and 20 seconds. The engine ran 1 hour, 15 minutes and 5 seconds. The maximum hight reached was 310 feet.

On this same day another flight established a record for aëroplane flying with an operator and one passenger. Major George O. Squier accompanied Mr. Wright on a flight that lasted 9 minutes, 6⅓ seconds.

Throughout these trials of September 12 the wind was blowing from the south with a velocity of from four to five miles per hour.

Fig. 8 shows the machine in full flight at a considerable elevation above the ground. Taken in connection with surrounding objects it is a most striking picture. Fig. 9 is another view of the machine in flight. The shape of the large planes and of the front rudder planes is clearly shown, and also the system of ribbing of these planes.

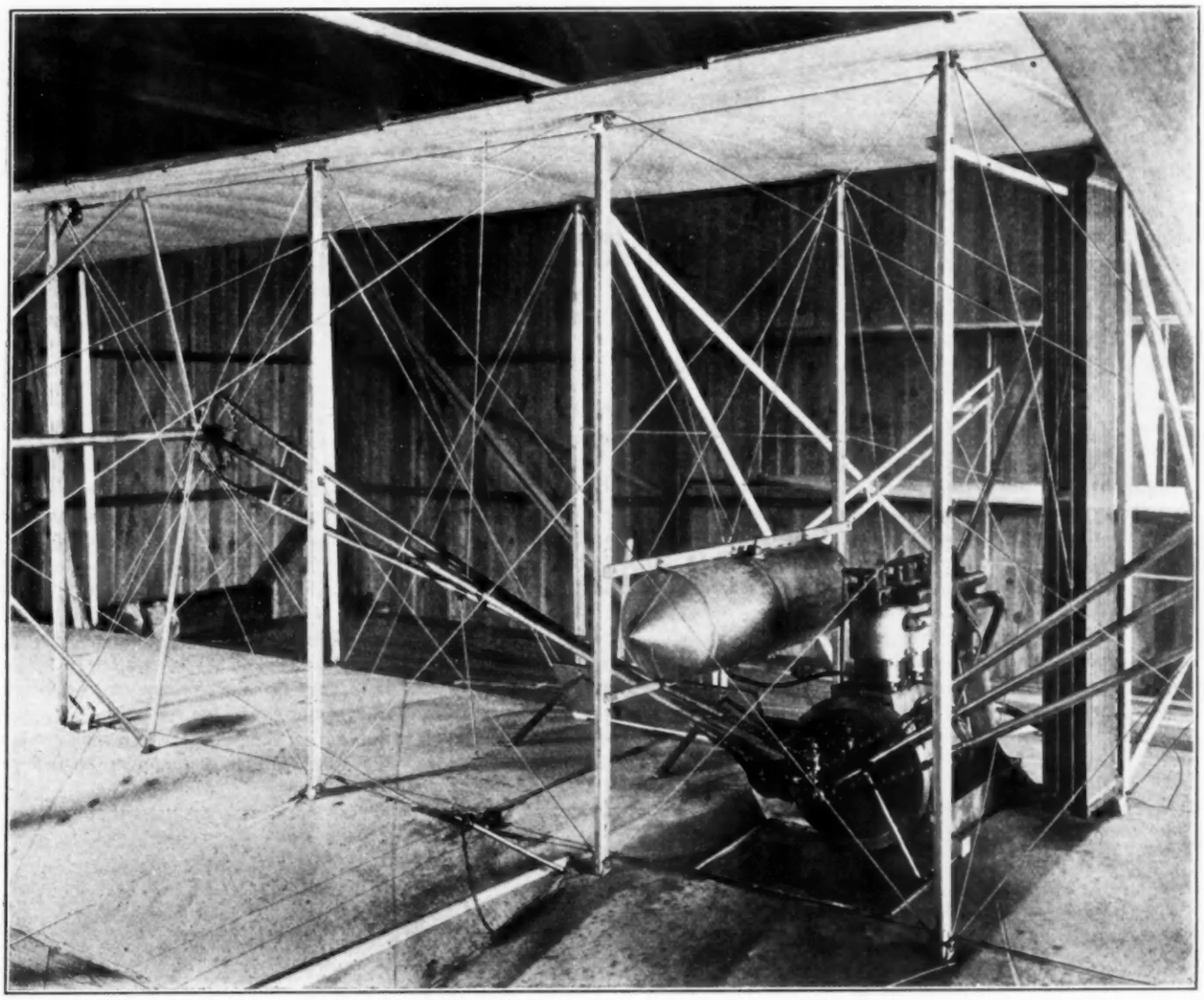


FIG. 7. THE POWER PLANT AND TRANSMISSION MACHINERY FROM THE REAR

What of the Future?

Speculations in regard to future developments of mechanical inventions are often interesting, but usually profitless. Yet parallels can sometimes be drawn that may give us a hint of future possibilities. The beginning of ocean navigation was Fulton's "Clermont." The beginning of railroad transportation was Trevithick's "iron horse." The beginning of aërial navigation is Wright's aëroplane.

Navigation of the sea by power began with the little "Clermont," which could carry only a few persons and make a speed of some four to six miles an hour on the smooth waters of the Hudson river. Steam navigation has developed until we now have the luxurious "Lusitania" that can carry 3000 persons, crew and passengers combined, is equipped with every convenience, comfort and luxury that civilization has developed, and can make a speed of some 28½ miles per hour.

Railway transportation began with the crude steam locomotive of Trevithick in 1804, which could make a speed of about four miles per hour, hauling a small load of freight. The luxury of railway transportation is perhaps best illustrated by the Twentieth Century Limited, a train of five superbly appointed cars, providing state rooms, drawing rooms, sleeping accommodations, a library, telephone service, baths, etc., and accommodating 125 persons, for the run between New York and Chicago in the brief space of 18 hours, or at an average speed of some 55 miles per hour.

Aërial navigation has started with the

Wright aëroplane, a flying machine that can carry two people and has flown at the rate of 45 miles per hour. It is simple in its construction and operation, and in those two points it parallels the "Clermont" and the Trevithick locomotive. After it has had the same degree of development that has been given to the steamboat and the steam locomotive, what will be its appointments and what will be its records?

Trade Opportunities in Central America

By M. de Moreira

The republics in Central America, though small, offer, nevertheless, to American manufacturers opportunities which the general public does not believe exist. It is a fact that the different republics of Central America give to manufacturers openings which they will not find in countries such as Argentina or Brazil. The financial conditions of most of them is also solid and getting better every year.

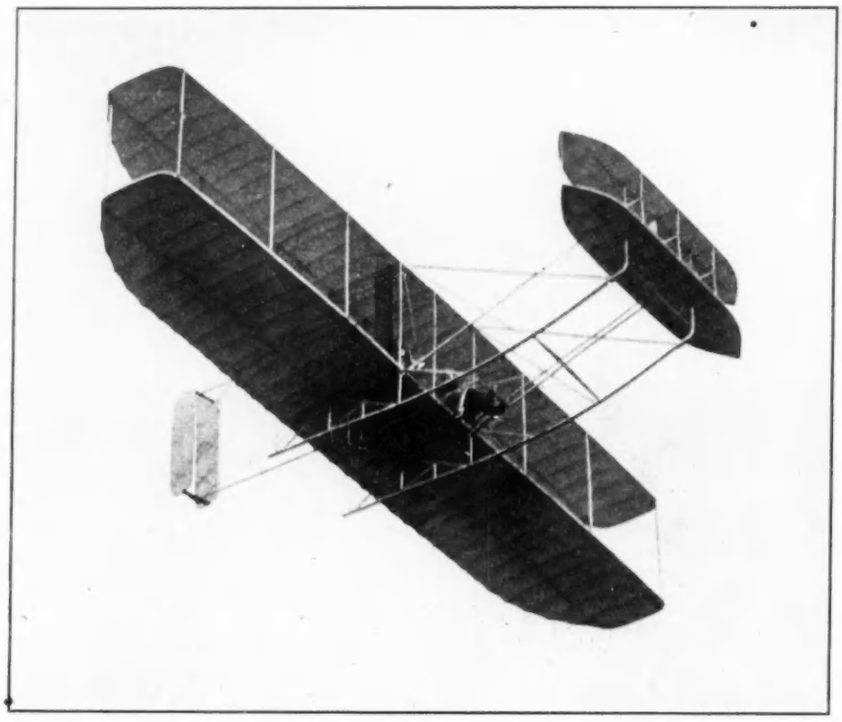


FIG. 9. IN FLIGHT—AN EXCELLENT UNDERNEATH VIEW

Costa Rica

Costa Rica receipts for the year 1907 aggregated to $3,958,234, or an excess of nearly $200,000 over the preceding year. The last statistics of the foreign trade of that republic amounted to $16,089,464; the imports were $7,278,464 and the exports $8,802,000. The United States leads in imports in Costa Rica, having contributed $3,964,224, or 54.4 per cent. of the total. This country is essentially agricultural; banana, cacao and coffee growing predominate. There is, however, some mining and smelting. A new mining and development company with an authorized capital of $100,000 has just been established in San José and is in need of modern machinery for mining, smelting and refining ores and metals.

Textile machinery will find a market there, as a company has just been established for the cultivation and manufacturing of fibers. The capital of that company is $500,000 and it must, during the term of its concession, cultivate 500,000 plants. To encourage the export of machinery the Government will give free entry to all machinery which can be beneficial to the country. Machinery and machine tools for repair and building shops are also needed on the road on the Pacific side. The Government is so anxious to increase its means of communication that lately it has appropriated $2,000,000 to be used in railway construction throughout the republic.

Santo Domingo

The financial condition of the Dominican republic is not as good as that of Costa Rica, as it has been affected by the stringency in the foreign markets and this is the cause for its limited importation during the past year. In spite of that, the total foreign commerce of the re-

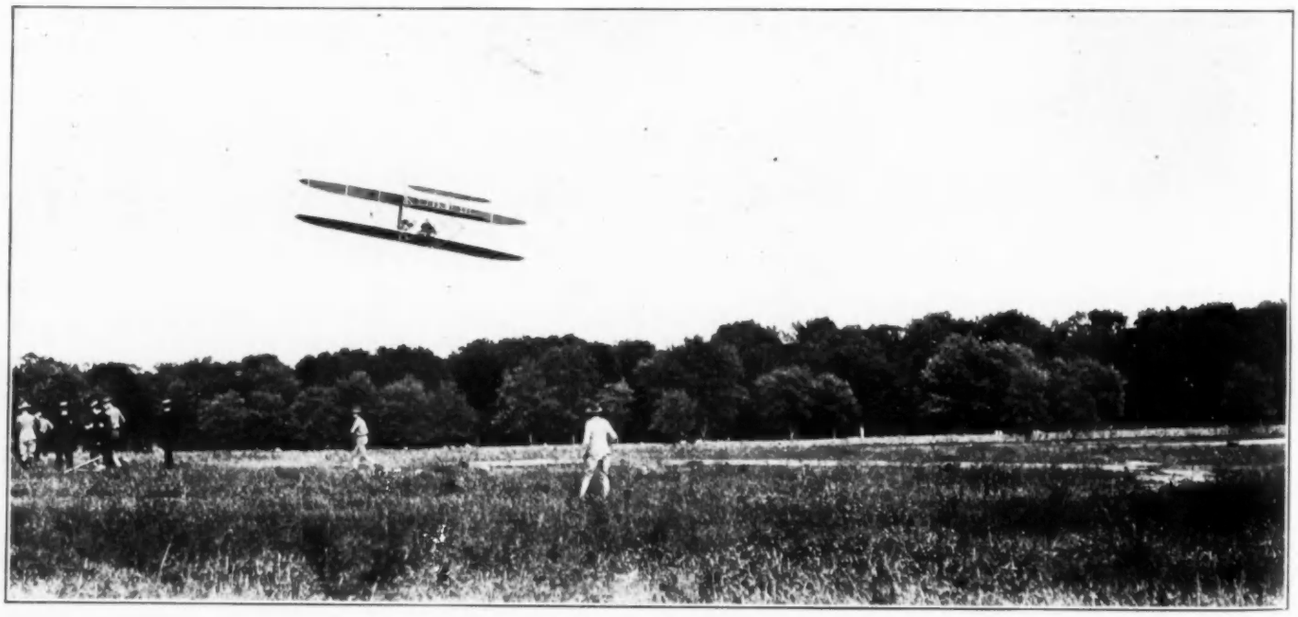


FIG. 8. IN FLIGHT

public was $12,500,000, which was $7,638,356 of exports and $4,948,961 of imports. The increase of both over the preceding year is about $3,000,000. The United States not only leads in exports, but has increased its share over the preceding year by $200,000.

Agriculture is one of the sources of wealth of Santo Domingo. Uptodate sugar machinery is much needed as many sugar plantations have been started lately, offering manufacturers of sugar machinery an opportunity to send there one of their representatives to make a thorough canvass of the sugar district to dispose of their machinery.

Veins of auriferous quartz are found all along the Central mountain chain. Copper is also found in great quantities. Several mines are worked which yield 33 per cent. of pure copper. Coal deposits are also worked, but with poor results for lack of machinery. The machinery used now in these mines is of very antiquated pattern and a manufacturer would do well, indeed, to study the needs of the people in that line. Machinery for well-drilling can be used at great advantage as the petroleum belt is quite extensive, its area being 190 square miles.

As is the case with the greater part of Latin America, railroads are very progressive. At present, four lines which connect the important center of production with the coast are being operated with great success. The Government is constructing a road to connect the port of La Romana with the city of Seybo. This road will give a great impulse to the cacao district. In general, machinery of all kinds for construction of the road and of bridges which are used on this line, would be sold easily if the manufacturer dealing in them would take the pains to bring his products to the attention of the natives.

Manufacturers of machinery for dredging and canalization should send their catalogs, or better, a representative to Santo Domingo and push the sales of these products which are much needed there. There is also a great opportunity for bridge building in the province of Monte Christi.

Guatemala

In Guatemala, the public revenues brought an increase of $5,148,500 over the budget estimate. The public debt, however, is very large amounting to over $12,000,000 for a population of 2,000,000 inhabitants. The foreign trade in 1907 was valued at $17,491,060, composed of imports of $7,316,574, and exports of $10,171,486, which was a great increase over the preceding year. As in the other two republics, the United States is at the head of the countries which import to Guatemala, having furnished 58.1 per cent. of the total imports.

Guatemala is less an agricultural country than Costa Rica or Santo Domingo, however coffee is an important product for which machinery with modern improvements is in much demand. Sawmill equipment could also be sold there as in 1906 over 2,116,000 square feet of timber was exported. Mines, though not rich, are neither very much nor very well exploited. The lack of means of transportation and primitive machinery are the principal drawbacks.

As far as manufacturing is concerned I think Guatemala is superior to many Latin American countries and offers manufacturers of machinery for shoemaking, furniture, hats, candles, soap, beer, etc., an opportunity to supply the different Guatemalan factories with improved machinery. The opening last January of the Trans-Continental railway of Guatemala has provided the continent with an ocean-to-ocean route, which will result in a great development of the country.

Haiti

Haiti may not be at present a desirable country to do business in, however, it is to be expected that peace will soon be established. At present the only opportunity offered to a manufacturer would be found in the numerous railroad contracts which have been granted lately. The last concessions were to build the railways and connect Gonaives with Hinche; Cape Haitien with Port au Prince; Gonthier with Fonds Parisien; Port au Prince with Leojane; Leojane with Coyes; Cape Haitien with Ouaneminthe and Coyes with Perin. All these railways will need rolling stock, repair and building machinery, tools, etc.

Honduras

Honduras has improved financially lately. The total foreign trade in 1907 amounted to $4,343,926, being $2,012,409 for exports and $2,331,517 for imports out of which the United States furnished 67 per cent. It is in the development of transportation facilities that the future of this country lies. A contract for railroad building between the banana plantations of the interior and the ports of shipment has been lately signed and as no machinery has as yet been bought, American machine manufacturers have a good opportunity with little fear of foreign competition.

Nicaragua

In Nicaragua the only thing of interest to machine manufacturers is the carrying out by the Government of the plans for reaching the Atlantic by rail. The construction of that road has already been started. The line from the Pacific at Corinto already exists; that port is reached by a railroad which extends to La Granade on the Lake Nicaragua. Branch railroads will connect the towns of the interior with Corinto. A new railroad is also under construction from Monkey Point on the Atlantic to San Miguelito, a distance of 116 miles. Shipbuilding exists on a small scale and the Companie Hondureña de Navegacion is extending its service of steamers along the Nicaraguan coast.

Cuba and Panama

It seems useless to speak here of Cuba and Panama. American manufacturers no doubt, are well posted and have studied very carefully the advantages offered to them in these two republics. There are a great many opportunities still there, more than in any other country in Central America, but manufacturers should be very careful concerning credits.

Regarding the credit of the countries mentioned in this article the only advice I can give the manufacturers is to make serious inquiries regarding the standing of the firms with whom they might do business and to be punctual in the filling of their orders in order to demand the same punctuality in the matter of payments.

A Steam Engine Which has been Running for Nine Years without Stopping

By E. A. Dixie

Some time ago a friend of mine who is fond of springing jokes on credulous people said to another friend of mine: "There is in the United States a steam engine which has been running continuously for over nine years without a single stop for repairs of any sort."

I know my friend and his fondness for jokes but I also know him to be truthful, and when the tale was retold to me I remarked, "If Johnson says it's so, it's so." Later on I got the story as follows:

In the natural-gas country there is a concern which makes lampblack, using natural gas as fuel. The gas is burnt and the soot or lampblack collects on screens. The lampblack is then brushed from these screens in the course of manufacture. Nine or ten years ago the concern installed a steam engine to do the brushing. As very little power was required the "steam" pipe of the engine was connected with the gas well, the natural pressure in the well being sufficient to drive the engine and brushes. The exhaust from the engine is in turn burnt and lampblack obtained from it. The speed and structure of the engine are such that the only necessary repairs, i.e., packing piston rod and valve stem, can be done while the engine is in motion.

The Cuban imports of dry glue in the fiscal year 1906 amounted to 410,294 pounds, of which the United States furnished 194,713 pounds, Germany 114,081 pounds, and France 42,909 pounds. The glue is used in the wood-working trades, from which there is an increasing demand.

Truth About the Hindley Worm and Wheel

Statements "A Hindley Worm Cannot Bear at the Mid-plane of a Wheel" and "Action Is Confined to the Mid-plane" Are Overthrown

BY OSCAR J. BEALE

Since the Hindley worm and worm-wheel were invented, about the middle of the eighteenth century, different statements have been published as to their action and as to the nature of the contact between the worm thread and the teeth of the wheel. It seems strange that, after more than one hundred and fifty years, investigators on mechanical subjects have been unable to agree regarding a mechanism consisting of only two members. For some years, I have thought that the construction of proper models would help to form correct opinions and lead to some changes in published statements. It is interesting to watch the progress of threading a Hindley worm and of the cutting of a Hindley worm-wheel. When beginning to cut the teeth of the worm-wheel there are so many grooves and ridges that it is difficult to predict what ridges will finally belong to the finished teeth.

Some years ago the Brown & Sharpe Manufacturing Company authorized the making of models of the Hindley worm and worm-wheel; but just what to make has been a problem that has been solved only during the last year. Various opinions have been formed only to be displaced by later opinions, until now every line of thought seems to emphasize the correctness of the solution that I propose to explain.

What is a Hindley Worm?

I understand that it is a piece threaded so as to conform to the curvature of a wheel called a Hindley worm-wheel, as at *a a*, Fig. 1, and at *b b*, Fig. 2, and that the threading tool for a worm is shaped like the tooth of a wheel the worm is to run with at the wheel's mid-section, or mid-plane; the tool moves in a circular path in the mid-plane of the worm, exactly as a tooth of the wheel moves. In Fig. 3, a tool is shown having sides at an angle of 30 degrees, shaped much like an ordinary worm-thread tool. This tool is in position to thread the worm *c*; it is carried by the plate *d* which is fastened to the index spindle, not shown. The index spindle and the worm arbor are connected with gearing, not shown, in any convenient way. Another tool is shown in position to thread a worm in Fig. 4; this tool is V-shaped and the cutting edges are at an angle of 81 degrees with each other.

If the tool is set to cut on one side of the mid-plane, or "out of center," a worm can be threaded that will look very much like a Hindley worm. In this article the worms described are cut on the mid-plane or central.

If a Hindley worm is gashed and the resulting teeth are relieved and hardened, and a wheel is cut with this worm or hob, that wheel is a Hindley worm-wheel. Of course, a worm will follow in any path cut with a hob shaped just like the worm. This is self-evident; it rests upon the same principle that any 1-inch piece will fit into any space that another 1-inch piece has cut. Any statements that have been published contrary to the foregoing should be corrected.

Teeth of this Worm-wheel Can Bear in Every Groove of Worm

A thin worm-wheel can be fitted to have teeth bear in every groove or convolution of the worm, as at *a a*, Fig. 1, and *b b*, Fig. 2.

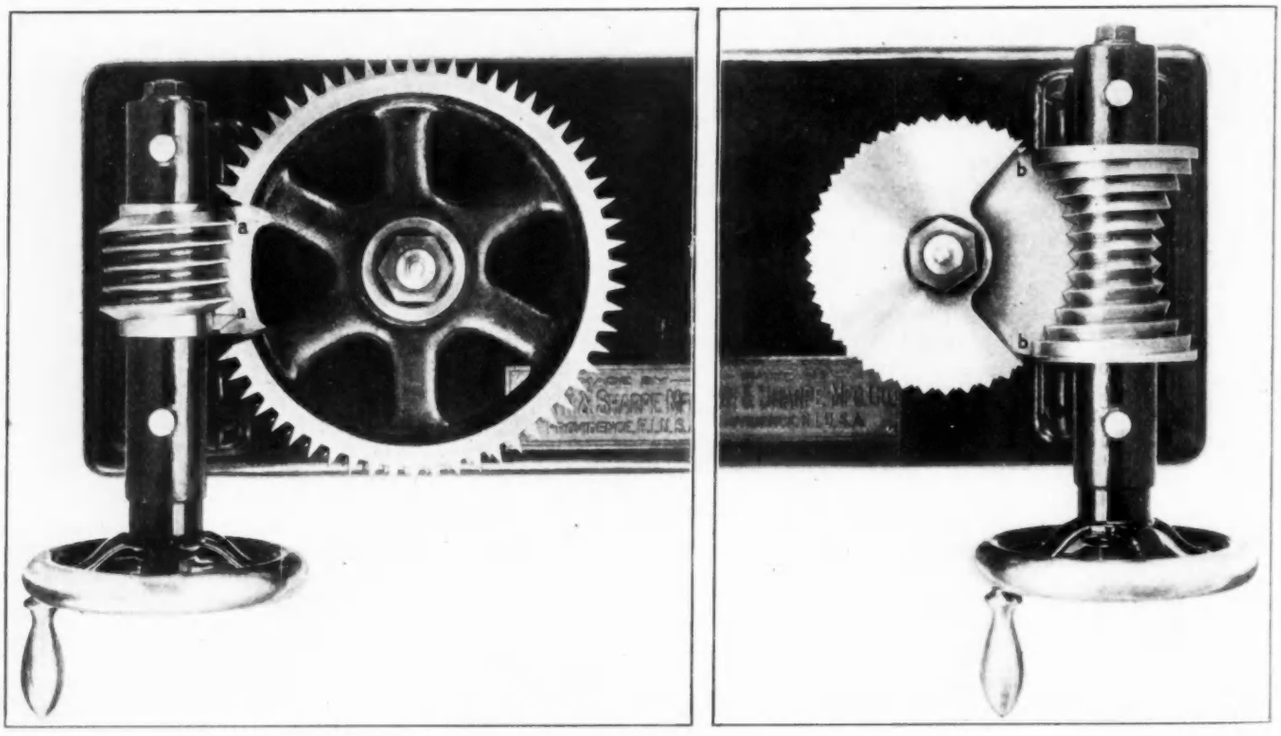


FIG. 1 TWO HINDLEY WORMS AND THEIR WHEELS, SHOWING TOOTH CONTACT FIG. 2

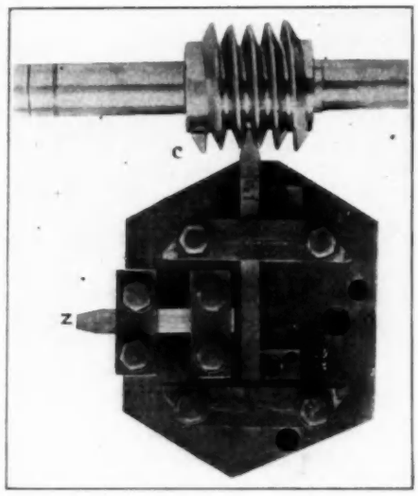


FIG. 3. THIRTY-DEGREE HINDLEY WORM-THREADING TOOL IN POSITION

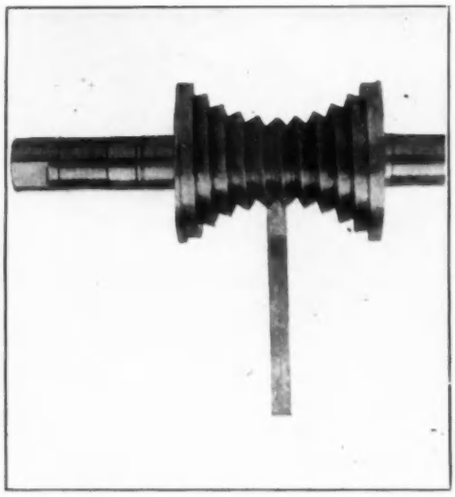


FIG. 4. EIGHTY-ONE-DEGREE HINDLEY WORM-THREADING TOOL IN POSITION

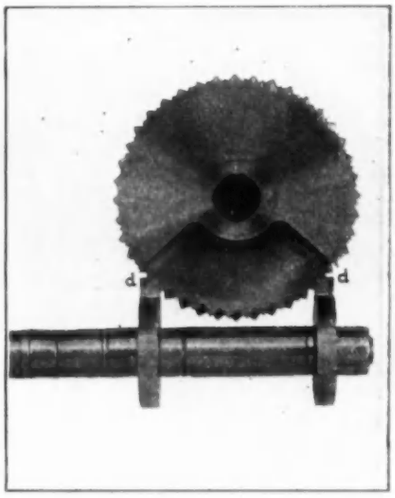


FIG. 5. TWO SIMPLE CUTTERS ARRANGED TO CUT A HINDLEY WORM-WHEEL

It is evident that the threading tool must cut a groove that is the counterpart of the tool itself; hence, a thin tooth shaped just like the tool can be fitted to every convolution, or groove, in the mid-plane of the worm. Therefore, a thin wheel can fit all the grooves in the mid-plane of a worm that is cut central, in every position to which the worm may be rotated. This proof is geometrical and does not require the construction of models.

Writers that have stated that a Hindley worm cannot bear at the mid-plane of a Hindley worm-wheel should correct their statements. A worm-wheel sectioned down to the mid-plane is shown in Fig. 1, at *a a*, and another worm-wheel sectioned down to the mid-plane is shown at *b b*, Fig. 2.

Now, if we have a wheel of considerable width of face, or thickness, with the teeth at the mid-plane fitting a Hindley worm, the worm and wheel will run together, if the teeth of the wheel do not interfere with the worm thread on either side of the mid-plane. Just here was where the question arose as to what to make. The worm could be threaded without any great difficulty. But the expense of cutting teeth in the Hindley hob and then relieving the teeth, in order to cut the wheel, seemed wellnigh prohibitive, when done merely for the purpose of investigation.

At the best, Hindley models are somewhat expensive, and whatever can be learned according to a necessary law of thought, without the making of difficult pieces, is a saving. It will be remembered that nearly all the truths in mathematics

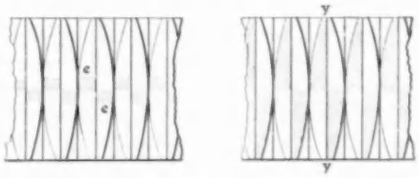


FIG. 7. DIAGRAM ILLUSTRATING BEARING POSITIONS OF WORM THREADS ON WHEEL TEETH

were learned through the necessary laws of thought, without any models. It was certainly desirable to avoid the making of a hob having so many convolutions, or threads, as are in the worm.

Only Two Simple Cutters Used for Model Worm-wheels

After considerable thought, I reasoned out that two cutters representing the outlines of the worm thread, at the two largest diameters of the worm, or at the ends of the thread, as at *b b*, Fig. 2, would cut the wheel very nearly the same as a complete hob having a great many teeth would cut it. The two cutters for the wheel in Fig. 2 are illustrated at *d d*, Fig. 5. These two cutters will cut just the same as a hob will cut at the mid-plane of the wheel; that is, these two cutters will cut a thin wheel that will fit and run with the worm in the mid-plane, as at *b b*, Fig. 2. But, in a thick wheel there is a bearing between the worm thread and the teeth of the wheel on each side of the mid-plane, as we leave the ends of the thread and approach the throat of the worm, on account of the increased angle of the thread in relation to the teeth of the wheel. In Fig. 6, this increased angle is easily seen at the throat near the square blade, as compared with the angle of the thread near the ends of the worm. This angularity causes the thread to bear on one side of the mid-plane of the wheel on one side of the teeth, and on the other side of the mid-plane on the other side of the teeth, or alternately, as at *e e*, Fig. 7. Theoretically, the teeth should be cut away at these bearings in order to let the worm in deep

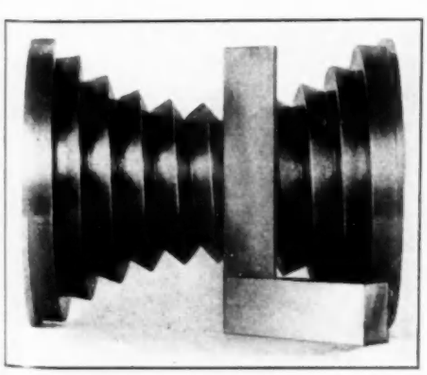


FIG. 6. SHOWING DECREASED THREAD ANGLE AT THE THROAT OF A HINDLEY WORM

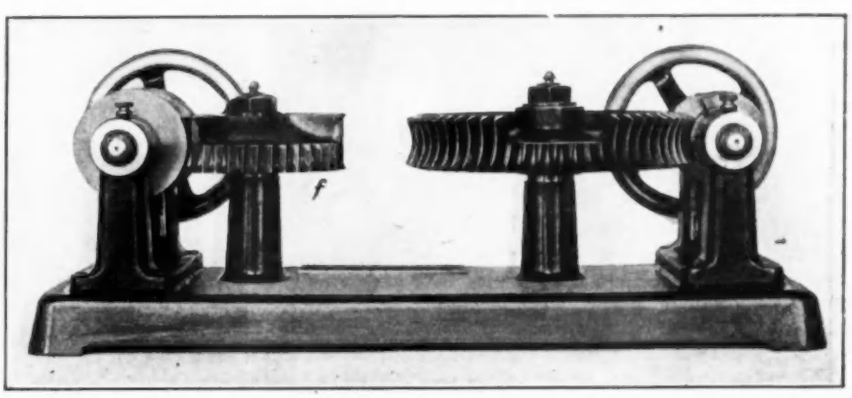


FIG. 8. WORMS AND WHEELS IN MESH

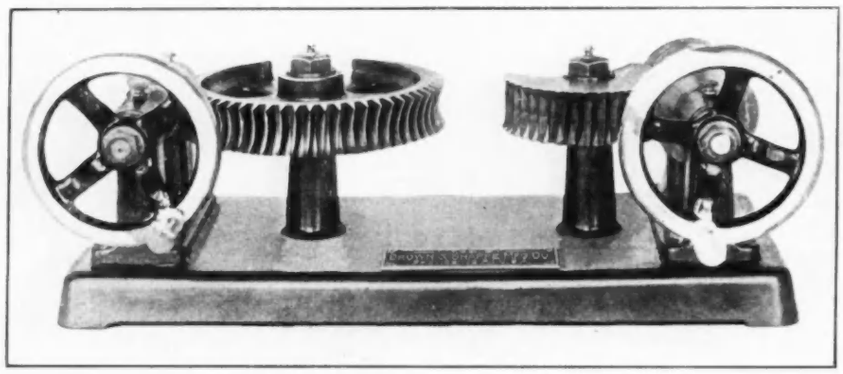


FIG. 9. WORMS AND WHEELS IN MESH

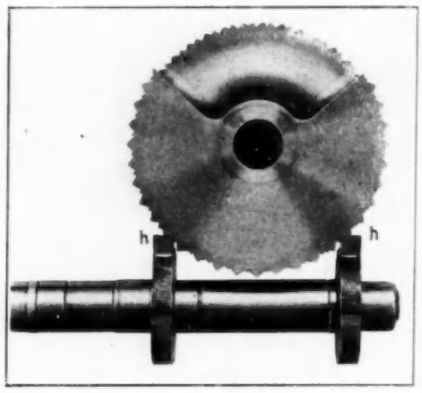


FIG. 10. SIMPLE WORM-WHEEL CUTTERS AT UPPER EDGE OF WHEEL

enough, but in practice I think no special cutting whatever will be needed. Certainly the teeth must not be cut away at the mid-plane.

And so the action is not "confined to the mid-plane," as has been so often stated by eminent writers on the principles of mechanism. These statements should be corrected. Among these writers I would mention Professor Willis and Professor MacCord.

The worm-wheel shown in different views, at *b b*, Fig. 2; at *f*, Fig. 8, and at the right in Fig. 9, was cut entirely with the two single-tooth cutters shown at *d d*, Fig. 5. In Fig. 5 the cutters are at the mid-plane of the wheel. In Fig. 10 the cutters are at the upper side of the wheel.

The cutters *h h*, Fig. 10, are shaped like the ends of the thread *i i* and *i*, Fig. 11. It is easy to see that if a hob is shaped like the worm in Fig. 11, that part of it that is between *i i* and *i* will not cut the teeth at the sides of the worm wheel, because at the throat *j* the thread and the teeth are widely separated at the sides of the wheel. Even though we make a hob, it will cut almost wholly at *i i* and *i*, and the wheel for all practical purposes will be the same as if cut with the two cutters *h h*, Fig. 10. Of course, a good hob would cut away a very slight amount already referred to at *e e*, Fig. 7. This amount is so very slight that it does not prevent the worms going in apparently the full depth at *b b*, Fig. 2.

This contact at one side of the mid-plane is normal to the side of the thread; this added to the contact at the mid-plane gives two lines of contact. The part of the tooth between the two lines is slightly depressed. Two contacts on the same side of a tooth can also be had in special cases of internal gearing.

Ends of Worm Threads Bear on Sides of Wheel Teeth

The two cutting edges *h h*, in Fig. 10, being the same as the ends of the thread at the two largest diameters *i i* and *i*, Fig. 11, it is clear that the ends of the thread at *i i* and *i* will bear upon the sides of the teeth in passing across, just the same as the cutting edges bore in cutting across.

So far as I know, this bearing of the ends of the thread upon the sides of the worm-wheel teeth has been overlooked by every writer upon the Hindley worm.

In the illustrations, as a worm has only one thread, there is a bearing of the ends of a thread for only a small part of a

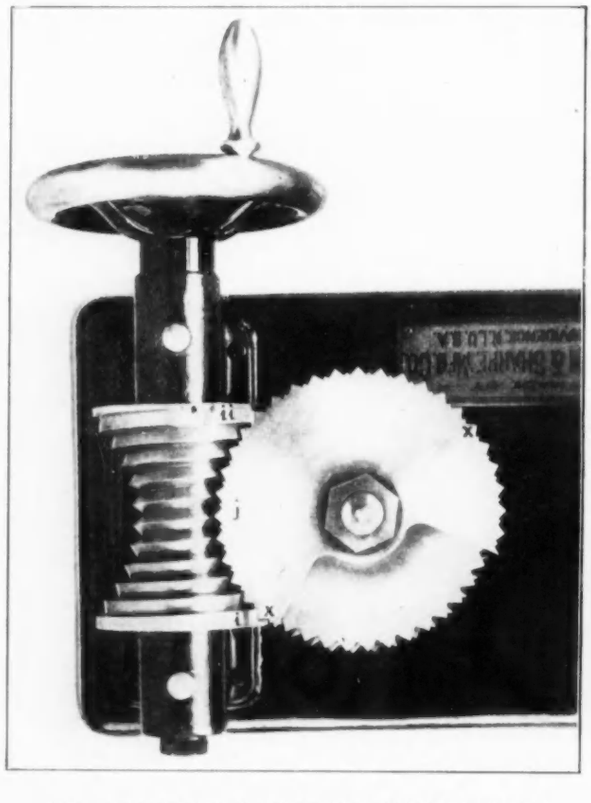


FIG. 11. THE ENDS OF THE WORM THREAD BEAR ON THE SIDES OF THE WHEEL TEETH

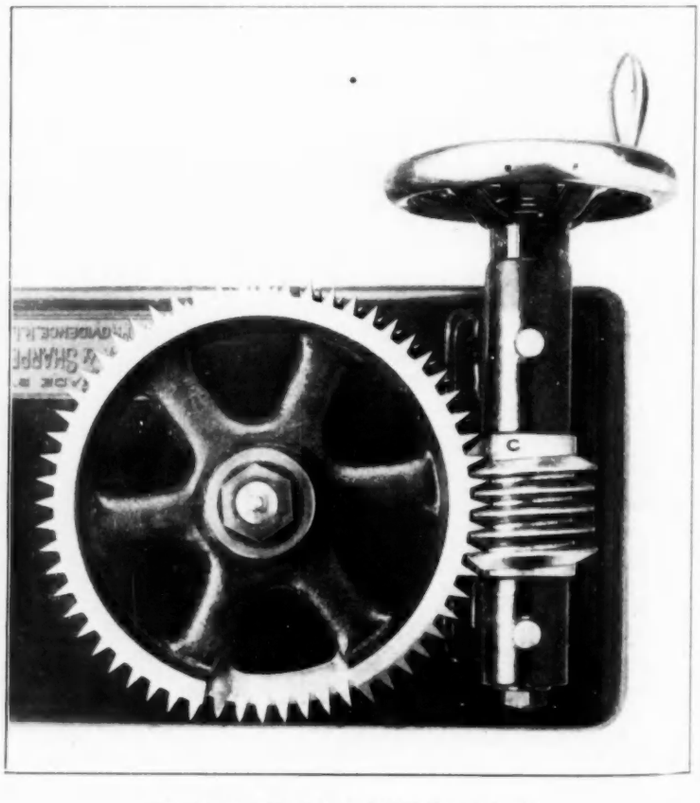


FIG. 12. THE ENDS OF THE THREAD WIPE THE WHOLE SIDE OF A TOOTH

revolution of the worm, but a multiple-threaded worm can be made that will have one or more thread ends in working action all the time. In such a worm, we can have the threads cut away except for a short distance at the ends of the worm and still have the worm drive the wheel.

There is still another bearing of the thread upon alternate parts of the teeth which can be understood in Fig. 11. Just to the left of the upper end of the thread, below *i i*, the under side of the thread bears very slightly harder than the very end of the thread bears, and the upper side, near the lower end, just to the right of *i*, bears harder than the very end. This is only another way of saying that the thread, in Fig. 11, bears slightly harder just away from the ends than at the very ends. The positions of these bearings is shown at *y y*, Fig. 7.

If the thread were cut away sufficiently at the ends, there would be no end bearings whatever.

Tooth Bearing on Lands

In Fig. 11, there are lands *x x* between the teeth proper which are more prominent than the teeth themselves. At the throat *j* a land is opposite a thread, but the distance between them is so great that they do not interfere. These lands may be regarded as useful teeth, inasmuch as the thread bears upon them. They are entirely cut away at the mid-plane, as seen in the right-hand worm of Fig. 9.

In Fig. 3 the tool *z* shapes the outer part of the worm *c*. The tools corresponding to the ends of the thread of this worm are seen in Figs. 13 and 14. In Fig. 13 the cutting edges are at the mid-plane, while in Fig. 14 they are at the side of the wheel nearest the eye. It will be seen that the inside of the thread of the worm *c* bears against the teeth at the ends of the thread in Fig. 12. In passing across, the end of the thread wipes the whole side of a tooth.

There were lands between the teeth in the wheel, Fig. 12, but as they interfered with the thread in the worm *c* they had to be cut away.

In the example made by Hindley and quoted by Professor Willis, in his "Principles of Mechanism," the worm has only 15 threads and the wheel has 360 teeth; hence this worm occupied only one-twenty-fourth part of the teeth of the wheel. In Fig. 12 the worm occupies one-tenth of the number of teeth in the wheel. With Hindley's comparatively short worm the facts spoken of in this article might be overlooked. The worm in Fig. 2 is purposely made quite long, occupying one-fourth the circumference of the worm wheel.

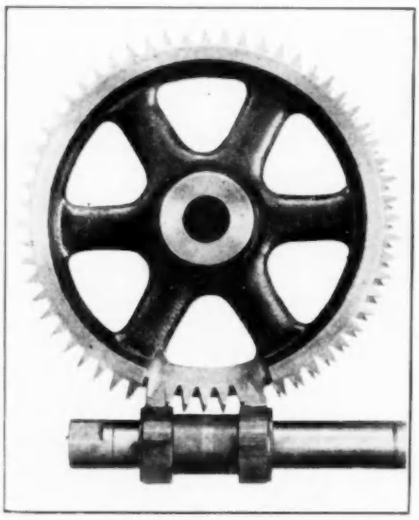


FIG. 13. TWO SIMPLE WORM-WHEEL CUTTING TOOLS SHOWN AT THE MID-PLANE OF THE WHEEL

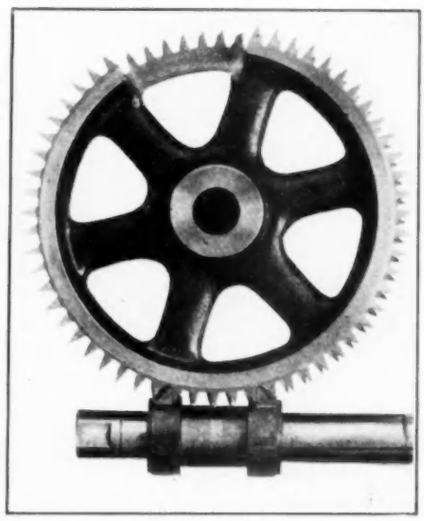


FIG. 14. THE SAME TOOLS SHOWN AT UPPER EDGE OF WORM-WHEEL

Helical Gears with Continuous Multiple Teeth

By Lucius W. Mayer

The advantages of helical gears have long been realized, though their adoption has by no means become general in this country. The field of use for the single helical gear is very limited, as it is adapted primarily for light work. It has been found impractical to use independent single-toothed helical gears where high speed or much power is an essential. This is due to the thrust parallel to the axis of the wheel, a resultant of the pressures in that direction.

An ideal arrangement would be a gear of the multiple-tooth type, in which the teeth were cut as portions of true helices, and cut continuously on the face of the same wheel. Such gears are manufactured in Paris, France, and it was the work of André Citroën, the inventor of the milling machine which cut these gears, which appeared to me worthy of recognition in American practice.

The work of turning out multiple helical gears for both large and small spur and bevel wheels, seemed well beyond the experimental stage. It is understood that the multiple gears are simply a duplication or repetition of the double helical type. The latter are best adapted for mechanisms which are to run in one direction, whereas the multiple type is best suited for gears which will be called upon to reverse the load.

"CITROEN"—CUT DOUBLE HELICAL OR MULTIPLE HELICAL GEARS

The helix angle with these gears is made 45 degrees, and has proven a distinct advantage over the 30-degree angle ordinarily made in helical gears. When the length of a single tooth has been cut, a reverse of the wheel is effected automatically and the cutter proceeds to mill the second half of the double-toothed gear, after making a sharp but fairly even curve at the apex of the two teeth.

The wheel finally coming from the machine is set up in the shop and tested for accuracy by being run with no load and at the specified speeds. The standard velocities for which the gears are built to run silently are: Bronze on bronze up to 3400 feet per minute peripheral speed; cast iron on cast iron or bronze up to 3000 feet per minute; steel on steel up to 1800 feet per minute.

Plans were being drawn in Paris for the construction of milling machines to handle wheels as high as 4 meters (13 feet) in diameter. Up to that time the maximum capacity of the milling machines was 8 feet in diameter.

The illustration shows the type of tooth.

The total production of petroleum in the United States for 1907 is reported as amounting to 166,095,335 barrels or 22,149,862 metric tons. This shows an increase of 39,601,399 barrels over the production of 1906. The amount of this increase is greater than the total product of petroleum in any year up to 1889. The average price decreased from $0.731 per barrel in 1906 to $0.723 in 1907.

Molding Machines for Machine Tool Castings

Benefits Derived from Use of Machines, Kind of Machine Adapted to This Work, Size of Castings Successfully Made, Molding a Side Frame

BY JOHN EDGAR

Machine tool builders, as a rule, are very slow to adopt the molding machine for the purpose of making their molds for castings in the foundry, but when certain conditions force them to it, as was the case in this instance, they find that a considerable saving in time and labor cost is the result.

In most cases machine-tool builders do not realize that many of their large castings can be successfully molded on machines and they have consequently confined the use of the molding machine to small work which is called "chicken feed" in the molder's parlance.

The piece herein described is one of the many interesting ones which was molded on a machine. It is an example of what can be done when the machine is used and the lower cost of production that was effected by its use is an assurance that the firm will not return to the old method of molding.

The job was that of molding the machine frame shown in Fig. 1. It was tackled after the machines had shown what they could do on such work as countershaft hangers, milling-machine tables, pulleys and such parts as are usually handled on the side floor. The machines used were of the roll-over type and the ramming was done by hand, with the use of ordinary molders' tools; but the work was handled, with few exceptions, by unskilled labor, trained in the use of ramming tools by a few weeks of teaching. Two men to a machine was the usual practice. These men could produce as many molds as three times their number of skilled molders, but, of course, the percentage of losses was greater. By careful supervising, however, these losses were reduced considerably and the good usable castings were increased.

Difficulties Encountered

There was much to be learned from the way the castings came out of the sand and many little points, that only the experienced molder is expected to know, were tried when using the machine; but these did not have the same good result as when used in the ordinary hand molding.

In the way of patterns, while many new ones had to be made, the process with the roll-over machines makes it possible to use almost any split pattern and many jobs were done by merely attaching the old pattern to a board. This was especially beneficial when an outside job called for only a few castings and the prospects of a future order were rather doubtful.

When it was decided to tackle this job it was with the intention of doing it on machines of a range sufficient to handle it. These machines were ordered, but when they arrived it was found that the range had not been enlarged sufficiently to handle this job. Patterns having been arranged for, some way was necessary whereby the benefits of the molding-machine process could be applied to this particular job. The machines for which these castings were used were manufactured in large lots and it was taxing the foundry to its fullest capacity to provide sufficient castings, by the old methods, and at the same time keep up the other work.

One skilled molder with a helper was producing one mold a day, by the old process, but when the molding machines were brought into use the work was

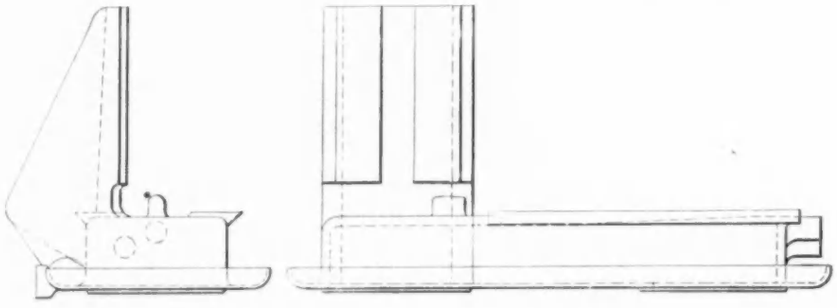


FIG. 1. SIDE FRAME CASTING AS MOLDED WITH MACHINE

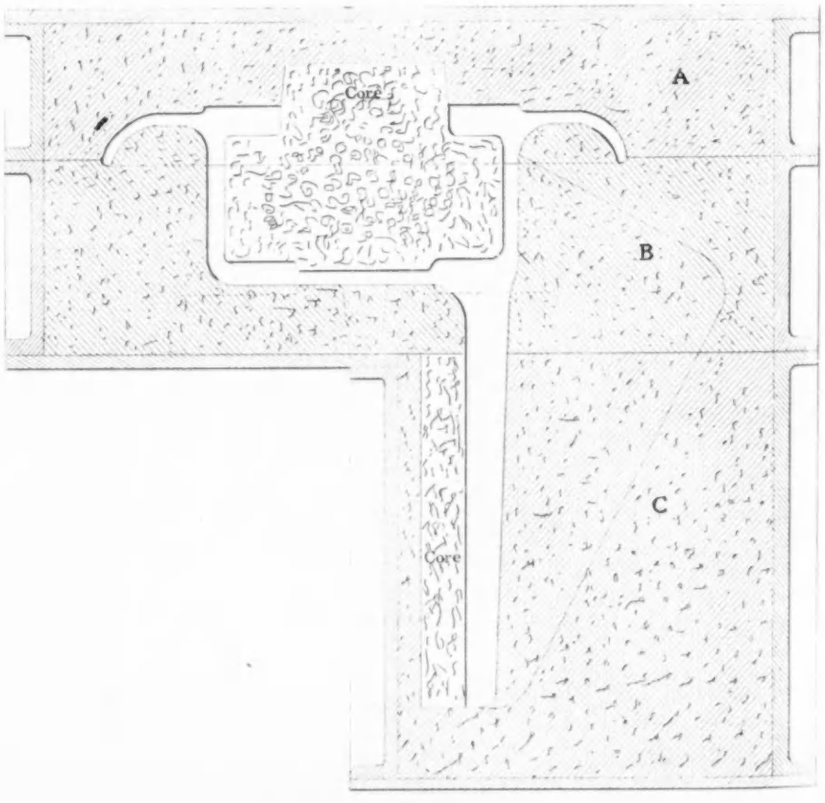


FIG. 2. SECTIONAL VIEW OF MOLD

easily kept up, as two unskilled men were making a mold in less than four hours.

Design of the Mold

It was finally decided to arrange the patterns so they could be used on the molding machine by making special arrangements to counteract the insufficient range the molding machines had. How this was accomplished is the interesting part of the job and a description may help someone to mold a similar job which they may have on hand.

Fig. 2 shows how the mold was made up. The cope *A* and nowel proper *B* (that part taking in the upper part of the bed) were handled on the machine, and the nowel extension *C*, in which the upright was rammed, was handled, by special means, off the machine. The upright of the frame extended about 18 inches from the top of the bed. The bed was 7 inches deep, 16 inches wide and about 48 inches long over the body. The pans extending about 4 inches all around. The bed was cored out, having a small opening through the top and a larger opening through the bottom. The section was box-shaped and the holes were used to lead the oil or cutting fluid from the top of the bed, or the pans, down through the hole, in the bottom, into a reservoir in the leg.

The casting was poured, as shown in Fig. 2, with the upright downward in order to obtain the top of the bed free from dirt, if any, collecting in the bottom where it would not show when the machine was set up.

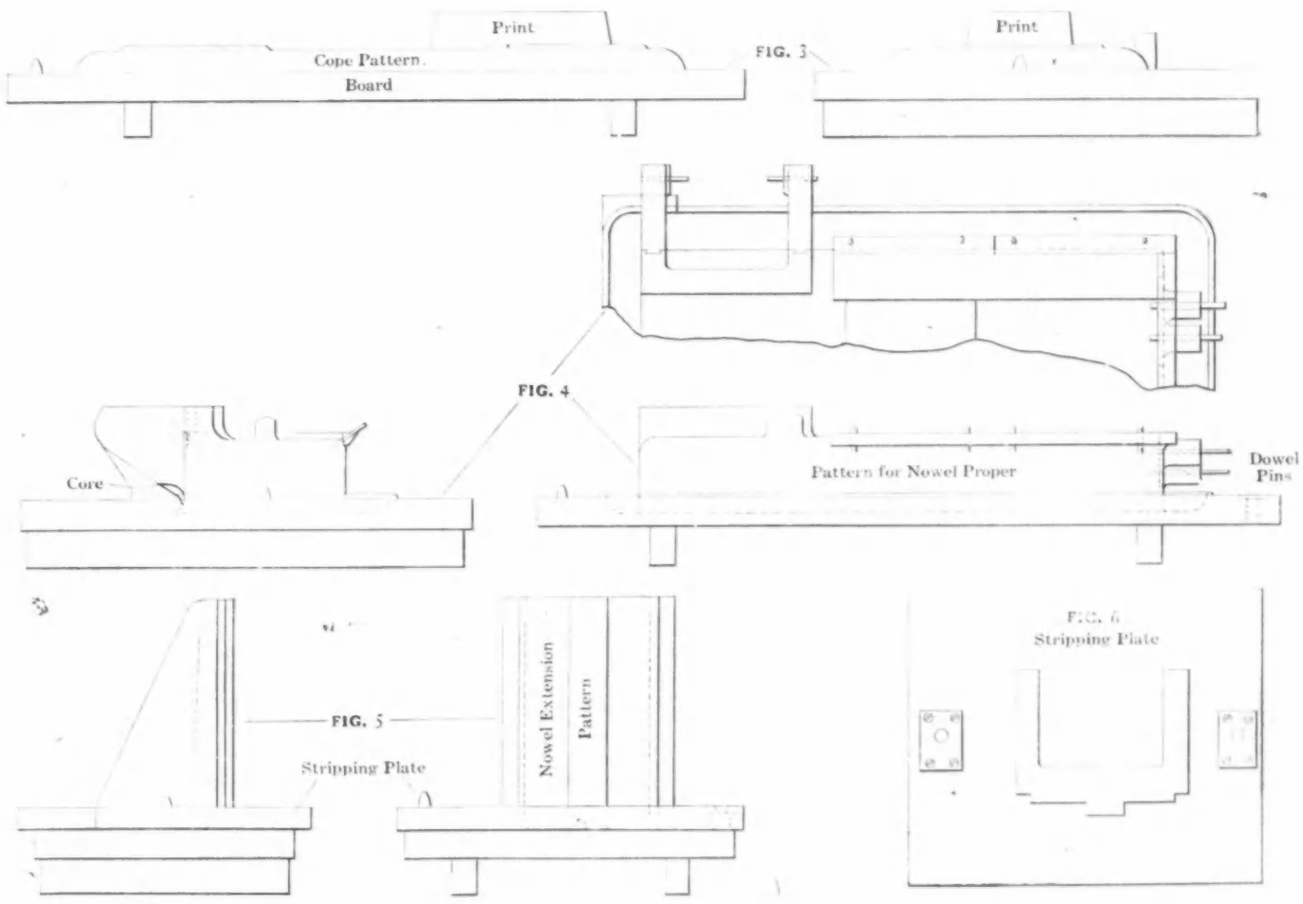
The pattern was made in sections which were divided at the parting lines of the flasks and attached to boards as shown in Figs. 3, 4 and 5; which are the cope, nowel proper, and the nowel extension. That part of the pattern in the nowel extension is provided with a stripping plate like that shown in Fig. 6.

Arrangement of Pattern

The boards on which the patterns were mounted were from 2 to 2½ inches thick and were braced by means of the cleats shown. One dowel and socket was placed in each board to prevent the reversal of the flasks on each other and thus prevent mismating the sections; which would be liable to happen were each board furnished with two dowels and sockets.

What a simple pattern the cope section was is shown by Fig. 3. The core for the bed was located by the core print shown in the cope *A*, Fig. 2, and it was hung in the cope. It was supported on the nowel by that part of the core which cuts the hole through the top of the bed. Fig. 4 shows the nowel section of the pattern for the bed proper. This is a more complicated pattern and has a number of loose pieces which have to be picked out of the mold after the pattern is drawn. The part of the upright flanges that come in this section are made loose and dovetailed and doweled in place. The angles of the slideway are also loose and are doweled, with loose dowels, while ramming them. The two bosses or hubs on the end are made fast to a plate which is set into the end of the bed in such a way as to properly locate the hubs. This is doweled, while ramming the sand around it, by loose pins through the hubs. The loose pieces can then be easily picked out of the sand after the body of the pattern has been drawn out. This section is quite deep as compared with the cope pattern in Fig. 3.

The boards are fastened to the frame of the molding machine by screws or clamps, and the flask is put in place, it being located by the dowels in the flask and the board. Each section is then rammed up, a bottom board is clamped to the flask, the whole swung or rolled over so that the pattern board comes on top, with the bottom board underneath resting on properly leveled supports. The clamps are then taken off, the vibrator set in motion and the board with the pattern is drawn from the mold. When the pat-



COPE AND NOWEL PARTS OF THE PATTERN ON THEIR BOARDS AND THE STRIPPING PLATE

tern is made with plenty of draft, the mold left by the pattern is clean and not torn as is generally the case with the hand-molded molds and hand-drawn pattern. This seems to be the most favorable point about molding machines of this type, as little "fixing up" of the mold is required. Very few skilled men can draw a complicated pattern from the sand in the ordinary way without tearing up the mold to a considerable extent and the patching and mending of the molds is one of the time-consuming operations that is done away with when patterns are molded on the machine as herein described.

Hand-made Mold to Fit Machine-made Molds

The molds *A* and *B*, Fig. 2, were thus produced on the machine, but section *C*, Fig. 2, was too deep a draw for the molding machine and an improvised method had to be arranged for molding it. This pattern had originally been fastened to the board as in Figs. 3 and 4, but for the reasons set forth above, it was removed from the board and an addition was put on equal to thickness of the stripper plate, when it was again fastened to the board as shown in Fig. 5. The stripper plate shown in Fig. 6 was cut out to slide over the pattern and was provided with dowels and sockets to locate it on both the board and the flask. The flask was then dropped in place; the sand rammed up; and the bottom board clamped to the flask and pattern board. This done the whole arrangement was rolled over by means of the crane and the clamps removed from the pattern board, the pattern was then drawn through the stripper plate in the usual way, the latter being held fast to the flask.

In this way the advantages of the molding machine method were obtained with but little more trouble than if a machine large enough had been available. But, of course, a machine of proper size would have been much better.

The molding of the nowel extension *C* was done by the same unskilled help that was used on the machines and for this reason the special arrangements described were made. The stripper plate was used to prevent any lateral movement of the pattern and to guide it while it was being drawn from the sand. It served its purpose admirably by preventing the sand from tearing out; a thing which is very liable to happen when unskilled hands do the drawing.

The mold as it looks when set up ready to pour is shown by Fig. 7.

Advantages of Molding Machines Over Hand Molding

After these experiences machine molding became a regular feature in the foundry of this concern and such large work as the smaller sizes of milling machine columns, were molded this way. The knees and saddles were also molded on the machine. The hand-rammed, roll-over type of machine that makes it possible to use ordinary split patterns that may be fastened to the board temporarily are the best suited for this work.

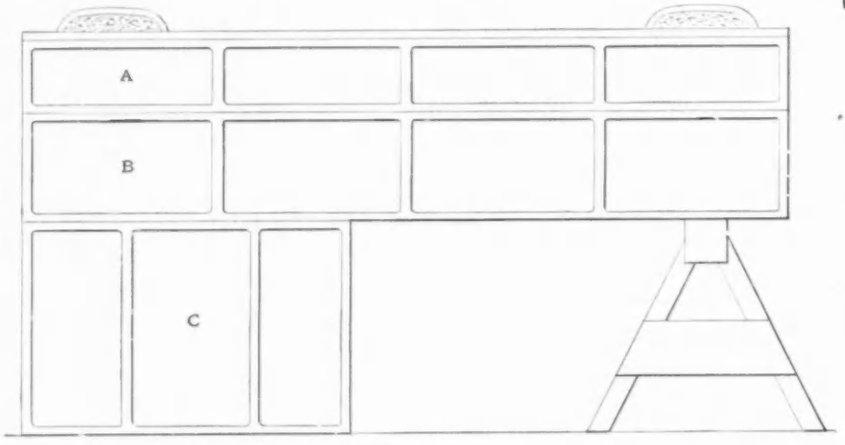


FIG. 7. COMPLETED MOLD READY TO POUR

The chief advantage of the molding machine over hand molding and the points that make it possible to employ a lower grade of help are: the established parting which makes it possible to ram the sand without any bedding; the straight-line drawing action of the machine which does not require the skill that is required in drawing a pattern from the sand without such guides, as is done in the hand operation; and the non-turning of the mold. The drawing-action of the machine, and the security with which the pattern is held to the flask through the pattern board and dowels, makes it unnecessary to rap the pattern so hard, and thus the distortion caused by the excessive rapping that the molder generally gives a pattern is not present. This makes the patterns last longer and the castings come out nearer the size of the pattern. This point was very clearly brought out by using some old patterns on the machines, for when the casting came to be machined it was found there was not enough finish allowance. The rapping is generally done by air-vibrators or when the air is not available the pattern board is vibrated by rapping with rawhide hammers or mallets and the effect is much different from that of rapping a pattern that is unsupported, except by the surrounding sand.

Details of Preparing Patterns and Core Boxes for Machine Molding

In fitting patterns for the molding machine great care ought to be given to the matter of draft, as much of the success depends on this. Possibly had this been more closely attended to in the patterns used for molding by the old methods much of the mending and patching would have been unnecessary. Ask any molder what is the most important feature in the pattern and nine times out of ten he will mention the draft. This is even of more importance in patterns constructed for use in molding machines, because the pattern is drawn in a straight-line action and is not allowed any lateral movement, such as is possible in the hand-drawn process.

Another matter in the construction of patterns for molding-machine work that is of considerable importance is the core prints. These should be generously beveled in the line of draft and also in such a way that they may be set with ease without filing. The number of cores naturally increases in molding-machine work, on account of the desirability of avoiding a number of loose pieces which could not be picked out conveniently. These increase in number with the more complicated work. If the prints are not beveled enough so that the core will drop into place without sliding on the sides of the mold, the core-setter will invariably file the core so much that it will be set out of place. But if proper care is used in making the core prints and boxes, much time can be saved in setting them. The core should never be made too tight a fit.

Every precaution should be taken to give the core-setter no reason for tampering with the cores. This he will do if there is the least interference between the core and the mold, and we can hardly blame him for it. But he is generally a timid fellow and makes no kick because of the bad fit until an investigation is made. Then, of course, everything comes out in the wash, and the blame is placed where it belongs.

There seems to be no reason why most machine-tool work cannot be done on the molding machine. Surely there are enough different types on the market to suit almost any kind of a job and now that they have obtained a start we may look for a general increase in their use in the future.

Friction Clutch Data *

By C. W. Hunt.

A long experience in the building of several varieties of friction clutches prompts me to add to Mr. Souther's paper some data relating to the coefficient of friction of the sliding surfaces of friction clutches, and also to discuss some paragraphs in order that designers may not be misled by hasty inferences drawn from the statements therein contained.

A friction clutch of the type under discussion is used to connect shafts in motion, in order that the shock caused by using inelastic jaw clutches may be avoided. When the two parts of a clutch are engaged, the friction surfaces slip, and in consequence are heated in proportion to the mechanical work expended in the slipping of the friction surface. When shafts are connected once or twice a day, for example a line shaft in a factory, the heating effect is soon dissipated. When clutches are frequently used, as in the case of countershafts of lathes, the heating effect may be evident, but the rise in temperature is so slight that the heat is dissipated before the next engagement of the clutch. When the friction clutch is used in such work as hoisting coal, where loads of from one to several tons must be hoisted two or three times a minute for hours in succession, the dissipation of the heat is the governing factor in the design.

It is necessary for the designer to know in advance whether the revolving shafts are to be disengaged while the power is still being applied to the driving shaft, or at a time when no power is being applied to the driving shaft. This condition is an important factor with any type of clutch, but especially is it so with the cone type. It is the governing one in deciding upon the mechanism for operating the moving parts, and it also limits the cone angles of the friction surfaces. It is the question which must first be decided, and its neglect has been the cause of serious disappointment to automobile engineers.

The centrifugal force, which in a rapidly revolving clutch tends to throw the lubricant from between the friction surfaces, is also of great importance in some designs.

The statement in paragraph 53 carries the idea that theory does not enter into the design of friction clutches, which is misleading. It certainly can and should enter into the design, and that automobile engineers have not used it is only evidence that they have not applied the knowledge that is available in this class of mechanism. The coefficient of friction in service is not unknown, but it is as definite as the strength of a steel bar, or the physical characteristics of any of the ordinary engineering materials.

FIG. 13

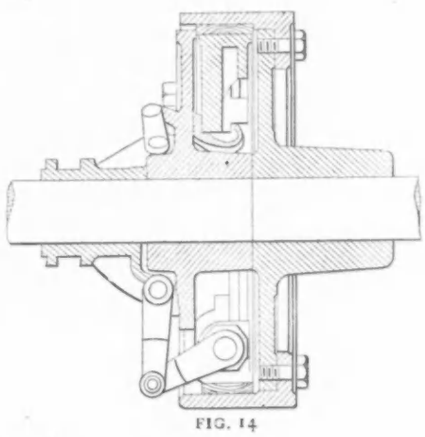


FIG. 14

MODERN ADAPTATION OF KOECHLIN CLUTCH

There are but few materials now used for making the friction surfaces. These are leather, wood, cork and metal. While other materials have been used, they vary but little in type from one of these materials and can be safely classified with one or the other of them.

For the design of commercial machinery, if the designer uses a coefficient of friction on iron of 0.35 for cork, 0.3 for leather, and 0.2 for wood, he will not be disappointed in the result. These figures are derived from a long and varied experience, and are to be used for clutches where the sliding surfaces are kept slightly oiled, a condition easily maintained in ordinary service.

When these friction clutches are liable to be flooded with oil, the clutches will work well if an adequate provision for disposing of the surplus oil is provided.

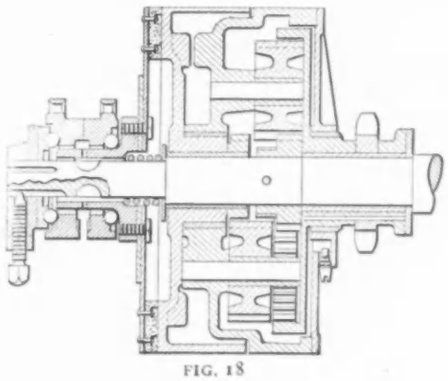


FIG. 18

A PLANETARY CLUTCH

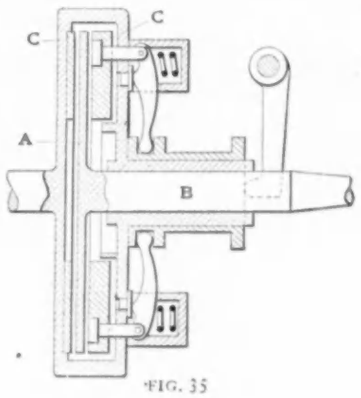


FIG. 35

A DISK CLUTCH

The following example illustrates one method. A clutch similar in type to that shown in Figs. 13 and 14, but with metal to metal friction surfaces, and a different mechanism for expanding the inner ring, has long been used. They have been in use without change of proportions for about 15 years, being thrown in and out of engagement from four to five hundred times per day. The sliding surfaces were about 14 inches in diameter, with a working face of 2½ inches. With a stress on the friction surfaces of from 1000 to 2000 pounds the clutch was adjusted to slip from ½ to 1½ inches when thrown into engagement. The expanding mechanism was correctly adjusted to secure this result under the ordinary conditions of service, but when flooded with oil, as it was liable to be, the parts would slip around and make one-half to a whole revolution before the surfaces would engage. A groove was then cut across the friction surfaces longitudinal with the shaft, ⅛ inch wide and 1/16 inch deep. This cross groove let the surplus lubricant out, and shortened the slip of the clutch. Additional grooves were cut across, until the slipping, when flooded, did not exceed the 1½ inches which had been fixed as the limit of movement. The distance apart of the grooves to accomplish this purpose proved to be a little over one inch, or a little less than the distance it was desired that the surfaces should slip.

Cone clutches have long been built in quantities for hoisting coal, pile driving and similar classes of work. Those built by the Lidgerwood company, of New York, and by J. S. Mundy, of Newark, usually have the cone surfaces at an angle

*Abstract of discussion on a paper presented at the June meeting of the American Society of Mechanical Engineers. The illustrations are reproduced from the original paper.

of from 20 to 22 degrees between the axis and the conical surface. These clutches require a pressure on them constantly while at work, but free themselves promptly either standing or running. The cone frictions built by another company have an angle of from 18 to 20 degrees, but are always accompanied by an operating device with which to pull the friction out as well as to press it in. The axial motion of a cone clutch of 20 degrees 36 inches in diameter, in regular service is from 1/20 to 1/16 inch. The loads hoisted by this clutch gave about 6000 pounds pull on the friction surfaces, which were leather and cast iron. They are engaged and disengaged four or five hundred times per day. The friction leather lasts for several years.

Contrary to the statement in paragraph 70, the engagement of a cone clutch is not a difficult problem, as large numbers of these are in daily service, operating without the slightest difficulty. The method of moving shown in Fig. 18 is admirable, and there are many other devices, the essential feature of which is the absence of lost motion, and great rigidity in the operating mechanism.

Cone clutches used on automobiles have usually been designed with a small angle, that is from 7 to 13 degrees, and with leather friction surfaces. These small angle clutches will not disengage when standing still, or when the power is not driving the machine.

The mechanism in current use on automobiles for withdrawing these clutches almost invariably has considerable spring, and sometimes slack motion in the joints in addition. This construction makes the cone clutch irregular in its action, and accounts for the complaints of the "fierce" action both in engaging and disengaging. If a rigid handling mechanism is used, and a larger angle cone, the difficulties will all disappear. The cone clutch then becomes admirably smooth in its engagement and disengagement. The moving mechanism shown in Fig. 18 is especially rigid in construction and satisfactory in automobile service.

The flat surface clutches used in automobiles manufactured by the De Dion Company of France, Fig. 35, and the American type made in Detroit, Fig. 18, may be considered mechanically as cone frictions of 90 degrees. They work with admirable smoothness, and would also work equally well with a conical clutch if the cone angle was 20 degrees or over. The strength of the springs needed to hold the surfaces in contact increases as the cone angle increases. The cut in Fig. 18 shows a clutch that is normally off, but the same makers also build for large cars a double-faced clutch of the same type, which is normally on.

Leather is usually used on the inner, and iron on the outer cone. It may be interesting to note that chrome leather wears equally as well as ordinary bark-tanned leather, and is very much superior when the surfaces run hot. When the clutch is large in diameter and the amount of slipping is great enough to heat the parts, then a difficulty sometimes arises from the fact that the leather is a non-conductor of heat, and when heat is generated at the point of sliding contact, the metal of the outer shell of the clutch becomes hotter, and consequently increases more in diameter than the inner one which supports the leather. If when a clutch is so heated it is left engaged until it cools, the outer cone will shrink more than the inner one, binding the leather so tightly that it is difficult to disengage the two parts of the clutch. For this reason, large size clutches are sometimes made with the non-conducting material attached to the exterior part of the cone, so that the inner cone will be the hotter one, then when the clutch cools, the inner cone will shrink away from the outer one and thus loosen the clutch.

A German Vertical Milling Machine

The substantial milling machine illustrated by the three half-tones, Figs. 1 to 3 inclusive, is built by Ludwig Loewe & Company, Berlin. The type illustrated by Fig. 2 is designated as No. 16, Model III. When equipped with a table for circular milling, as shown by Fig. 1, it is designated as Model III R.

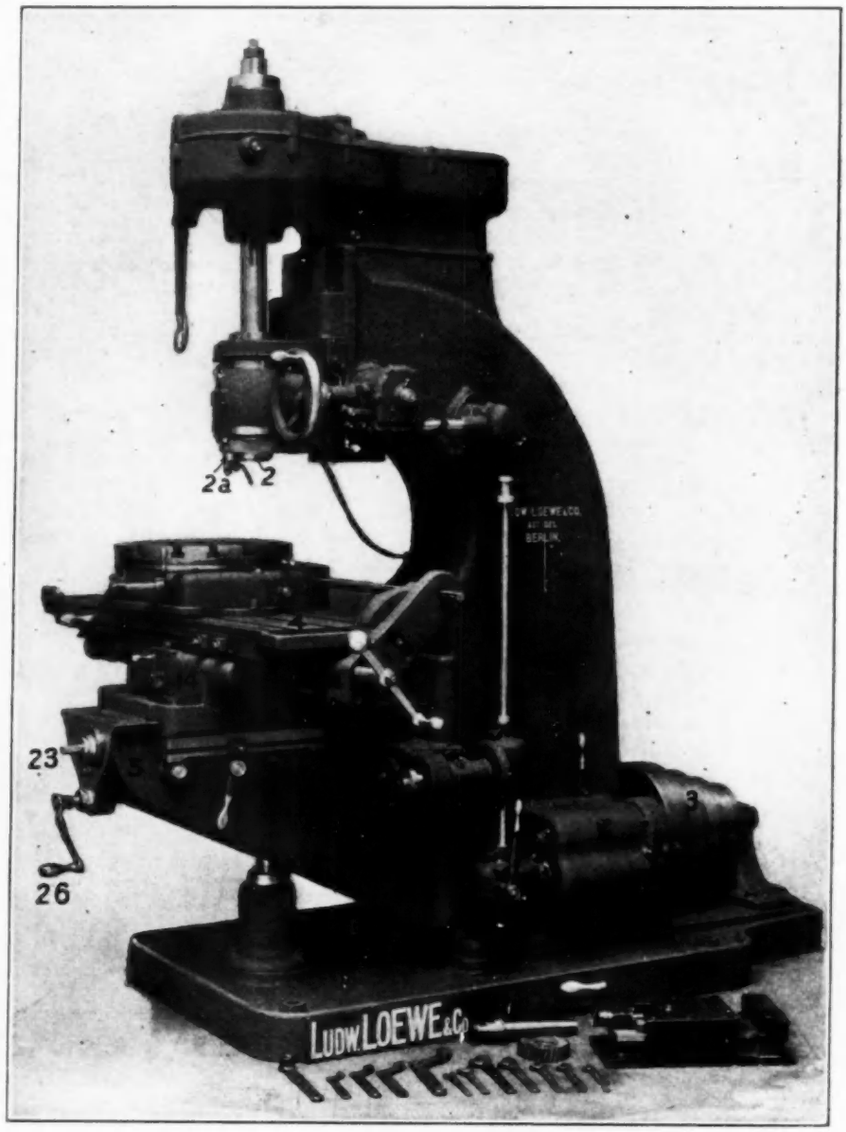


FIG. 1. A GERMAN VERTICAL MILLING MACHINE ARRANGED FOR CIRCULAR MILLING

The Drive

The drive is through a four-step cone from an overhead countershaft, although a gear box 9 can be provided for motor drives, as shown by Fig. 3. The stepped cone transmits its motion to a bevel gear on a vertical shaft that extends upward through the pillar of the machine. From this point the motion is transmitted to the spindle by two systems of gearing; the one has the ratio of 1 to 1; the other a ratio of 1 to 5. Thus it is possible to

give two different speeds to the spindle for each of the four speeds of the driving shaft. These eight different speeds form a geometrical progression having the limits of 13 and 200 revolutions per minute. All of the bearings of the main drive are lined with phosphor-bronze bushings, and are provided with a carefully designed oiling system.

The spindle slide 1 is counterbalanced by a counterweight contained in the pillar. It can be clamped in any desired position to the upper dovetailed face of the pillar by a locking gib and eccentric bolt.

An auxiliary spindle is indicated at 2*A*, and is driven through three spur gears from the main spindle 2. The intermediate gear of this train is carried on an eccentric stud and can be thrown into or out of action by a lever. The gearing ratio is such that it revolves 2.27 times faster than the main spindle, and thus has eight speeds between the limit of 30 and 450 revolutions per minute.

The Feed

The feed drive is positive, and is taken from the driving shaft near the base of the pillar through spur gears contained in the gear box 12. This provides twelve different feeds arranged in a geometric progression. This box not only provides the feed for the table traverse, but also for the movement of the table slide along the knee, for the circular table in circular milling and for both the main and auxiliary spindles. All of the bearings in this feed-gear box are carefully oiled from a common oil reservoir; the conducting system is composed of brass pipe. A light removable cover is fitted over this gear box so that it can be readily removed at any time in order to inspect the gears.

Directly in front of the gear box is a small case containing the main feed-operating mechanism. This consists of three bevel gears and a jaw clutch manipulated by a hand lever that is plainly shown. Through this mechanism the vertical shaft 15 is driven. This shaft is entirely external to the pillar.

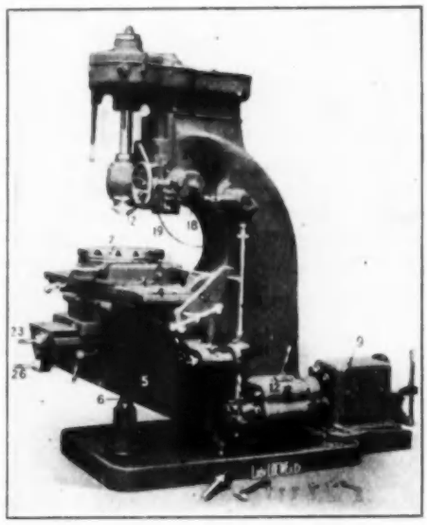


FIG. 3. ARRANGED FOR MOTOR DRIVE

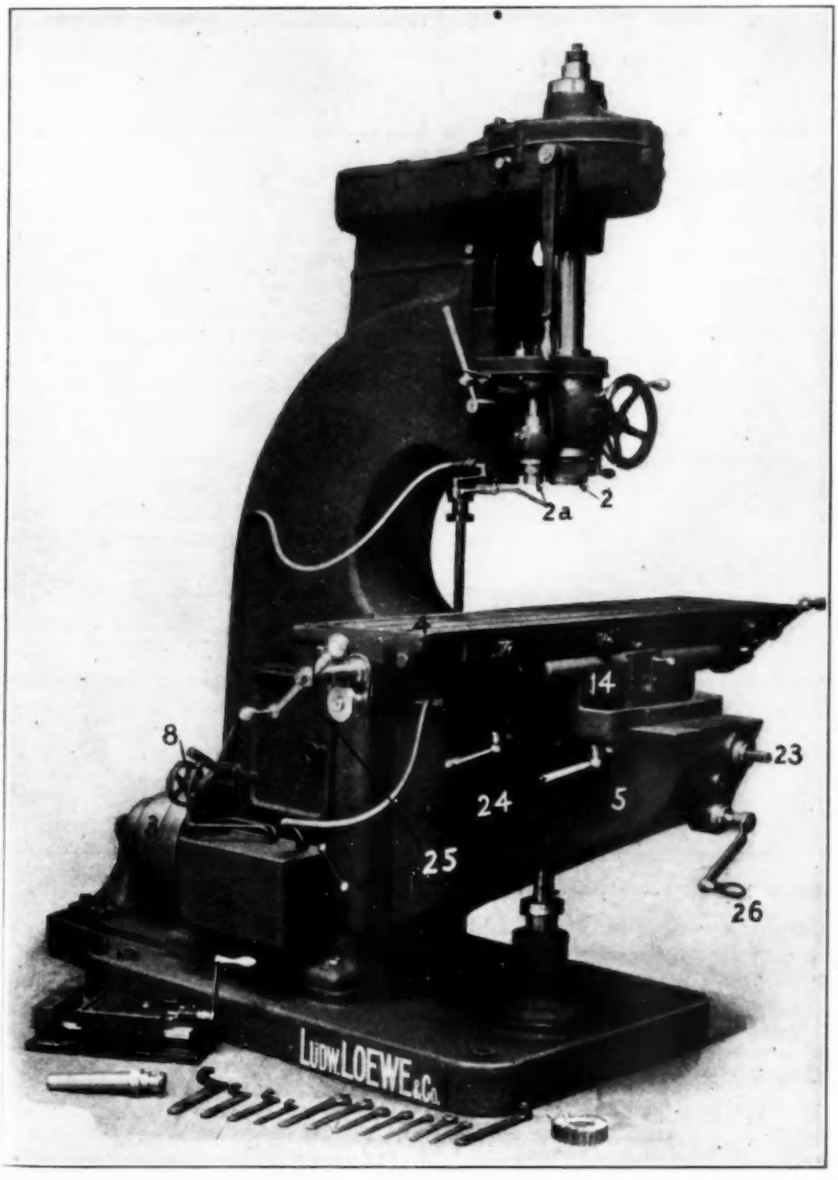


FIG. 2. ANOTHER VIEW OF THE GERMAN VERTICAL MILLING MACHINE

The spindle feed is taken from this vertical shaft 15 through bevel gears 16, an universal jointed shaft 17 and a worm-gear drive 18. A self-acting trip is provided so that it is impossible for the spindle slide to over-run its normal travel.

Hand adjustment of the spindle slide is accomplished through a hand wheel, bevel gears and a screw. A graduated scale permits of accurate setting to within one-fiftieth of a millimeter. The twelve feeds of the spindle slide lie between 0.02 and 2.0 millimeters per revolution of the main spindle.

The feed of the knee slide 14 is through bevel gears 21 from the vertical shaft 15. The feed of this slide is exactly the same as the feed of the table. It can be reversed at any point of its travel. Hand adjustment of this slide is through the handle 23, and by means of a graduated scale settings can be made accurately to the one-fiftieth part of a millimeter. The slide can be clamped to the knee by means of the clamping bolts 24 and in a similar way the knee can be clamped to the pillar by the screws 25. The handle 26 operates the vertical travel of the knee and acts through a system of bevel gears and the telescoping screw 6. The gearing ratio is 1 to 3.

The table feed comes from the common feed shaft 15. It can be reversed at any point, and stops are provided to prevent the table from over-running its normal travel. The working dimensions of the table are 59x14¾ inches. The maximum length of traverse of the table is 39⅜ inches. The diameter of the table of the circular milling attachment is 20 inches.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Some Homemade Tools

One of the toolmakers in our shop spends most of his spare time making tools of various kinds for his "outfit." Many of the things he makes could doubtless be bought for considerably less than they actually cost him, but on the other hand several of the articles did not cost him in either time or money, one-tenth of the catalog prices, and too, a number of his most useful tools are not listed in any catalog, though very likely similar ones exist elsewhere.

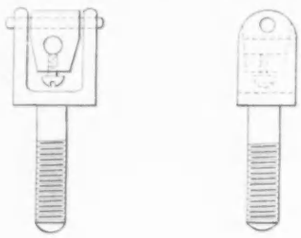


FIG. 9. SWIVEL JOINT FOR INDICATOR NEEDLE

One of the latter class is shown in Fig. 1, and consists of two sliding or adjustable caliper attachments for the ordinary grooved scale. These parts are extremely useful for many things, being easily attached to any grooved scale of the right thickness, whether six inches or three feet in length. The scale shown is an extra wide one, but the groove is the usual distance from the upper edge. If it is desired to use the arrangement as an ordinary caliper, the micrometer head is easily taken out and two sliding anvil bars used as in Fig. 2.

The principle on which the attachments are made is the same as that of the other common scale attachments, the hook and lock nut being used to lock them firmly in place at any point along the scale.

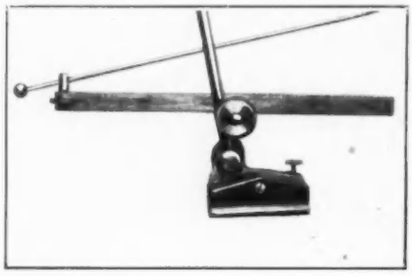


FIG. 7. INDICATOR ATTACHED TO SURFACE GAGE

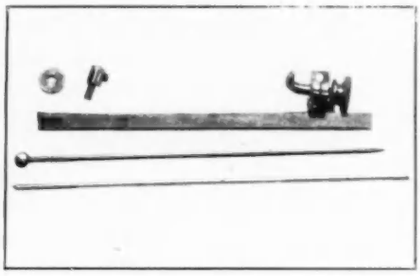


FIG. 8. INDICATOR PARTS

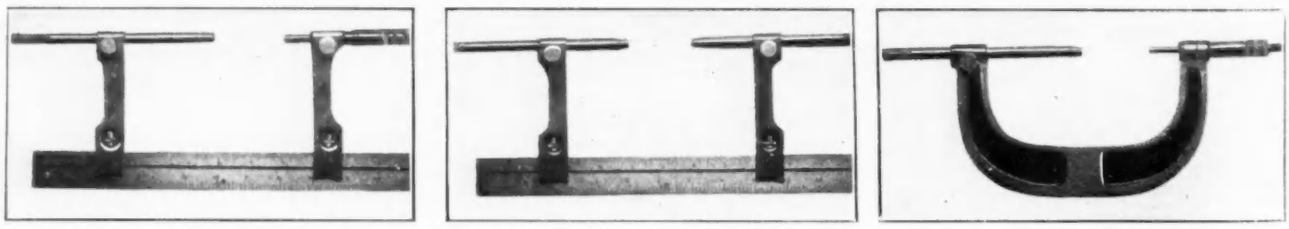
These attachments should have been made with wider bases where they come in contact with the top of the scale, in which case less care would be needed to make them set firmly and perfectly square with the scale.

Fig. 3 shows a solid frame caliper that measures from zero to six inches by thousandths. The actual money cost of this was $4, the micrometer head costing $3.75 and the rest of the material 25 cents. The frame pattern, our toolmaker made himself at odd times, it being practically the same as a regular 6-inch Brown & Sharpe, except that the end where the micrometer barrel slips in is made considerably larger. The micrometer head is not fastened in, but is just a good fit for the hole in the frame. He also made a 12-inch frame in the same way and uses the same heads for both frames, the principal difference being the size, and that a 7/16 sliding bar is used instead of the 3/8 bar which is used in the smaller frame.

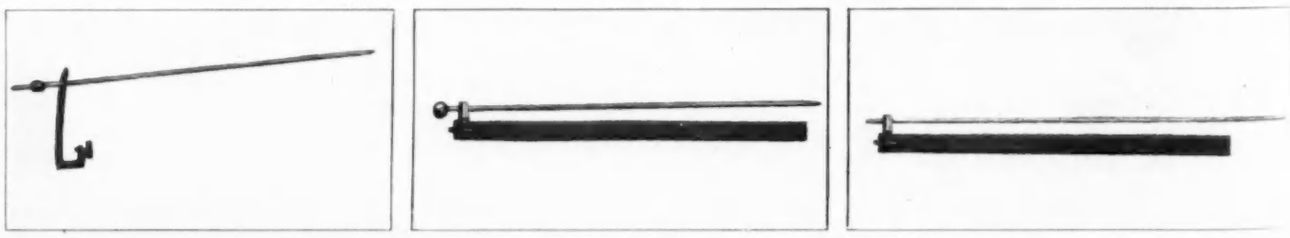
The tool in Fig. 4 is the old-fashioned "wiggle stick," the spring for which is an extra heavy piece out of an old music box. A small clamp is riveted to one end of this spring which makes it very easy to attach the "wiggler" to any handy lathe tool.

Figs. 5 and 6 show two views of another "wiggler," one with a sharp and the other with a ball point.

Fig. 7 shows it attached to a surface gage, while Fig. 8 illustrates the parts, which need no explanation, except the



FIGS. 1, 2 AND 3. HOMEMADE MEASURING APPLIANCES



FIGS. 4, 5 AND 6. HOMEMADE WIGGLER OR INDICATOR

swivel point which holds the indicator needle. This is shown in detail in the sketch, Fig. 9. As will be seen from this, the weight of the needle alone is used to keep the point in contact with the center-punch mark, or the work when the ball is used.

When used as a wiggler to locate a punch mark, the lock nut on the swivel is loosened, but when it is used on the rim of a pulley or for similar work the lock nut is tightened. Two needles are used, as a ball made to slip over the end of the needle is very liable to get lost.

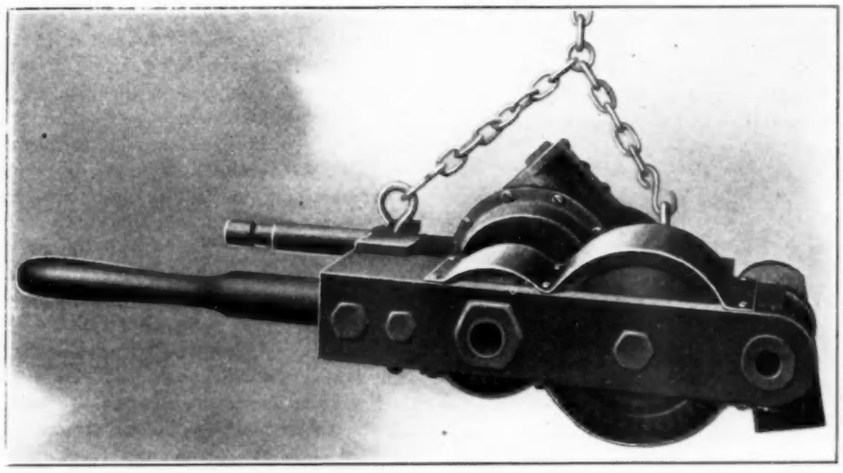


FIG. 10. AN ADDITION TO A REGULAR PNEUMATIC DRILL

In building some machines, a hole 1¼ inches in diameter had to be drilled from the inside of a space 11 inches wide, and as there were a good many holes to be drilled in the course of a year, the attachment shown in the cut was added to a regular pneumatic drill. *A* is the original drill socket and *B* is the one used when drilling the hole just mentioned, the framework and the three gears being added as shown in Fig. 10.

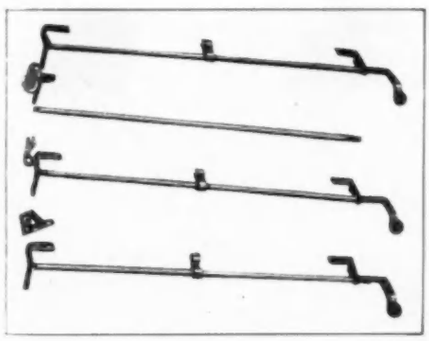


FIG. 11. THE WORK

For use in typewriter construction, considerable difficulty was experienced in making the parts shown in Fig. 11.

The part consists of a piece of ⅛-inch rod about a foot long to which are brazed three fittings, two of which are made of sheet metal.

All kinds of schemes were tried but proved expensive and unsatisfactory until C. A. Diller, toolroom foreman for Remington-Sholes Company, made the electric brazer shown in Fig. 12.

The machine itself is simply a set of clamps designed to hold the wire and the three fittings firmly in the desired position.

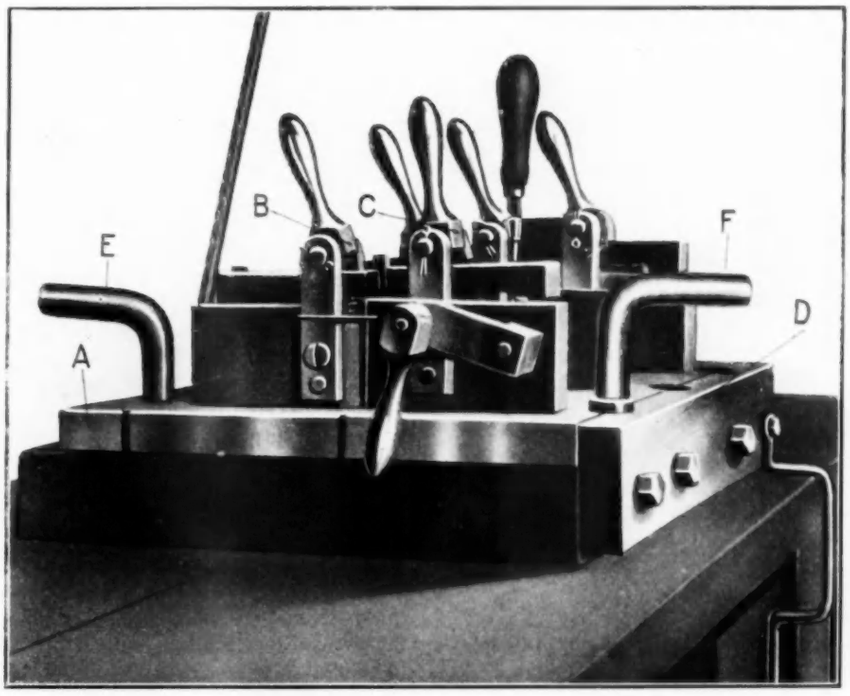


FIG. 12. THE ELECTRIC BRAZING MACHINE

These clamps are in three sets well insulated from each other. Each set is made up of two clamps *B* and *C* also insulated from each other. One clamp of the set holds the wire and the other the fitting in such a way that when a current is run through the clamps, heat will be generated at the point of contact between the wire and fitting.

The electric terminals are connected to the iron plates *A* and *D*, both of which are insulated from the clamp sets.

When it is desired to braze a piece it is clamped into the machine and the plugs *E* and *F* inserted in the holes opposite the fitting which is to be brazed first. This completes the circuit in the machine itself so that when the switch is thrown over, a current of electricity passes through the clamps and heats the parts desired. Flux and brass are applied in the usual way, the switch handle moved back, the plugs moved to the next pair of holes and the work done as before.

Only an instant is needed to braze the parts and the job is clean and well done, little dressing being needed, and absolutely no warping occurring as the use of a gas blowpipe is apt to cause in metal as thin as this.

Decatur, Ill. ETHAN VIALL.

Dividing on the Engine Lathe

I had to make a reamer with 20 teeth and having no dividing attachment for the miller, I decided to mark it out on lathe. The usual method in such a case is to find a train of wheels such that the lead screw makes as many revolutions for one of the spindle as divisions are required. Then by moving the spindle round until the lead screw makes one complete revolution, the necessary fraction of a spindle revolution is obtained. On the lathe in question, however, there was no convenience for a compound train of wheels, and a simple train having a ratio of 20 to 1 was out of the question, the wheels ranging from 24 to 90 teeth.

The idea occurred to me that while I could not make the spindle move 1/20 revolution for one revolution of the lead

screw, I could easily arrange for a ratio of 19 to 20 or 21 to 20 and thus move the spindle 19/20 or 1 1/20 revolutions for each revolution of the lead screw. An 80-tooth wheel on the spindle and a 76 on the lead screw gave me the 19 to 20 ratio, and by revolving the lead screw once the spindle made 19/20 revolution, each mark coming 1/20 revolution behind the previous one. An 80-wheel on the spindle and an 84 on the lead screw gave ratio 21 to 20, the spindle revolving 21/20 revolution for one revolution of the lead screw, each mark coming 1/20 revolution in front of the previous one. The choice of method depends, of course, on available wheels. I have used this method several times with success.

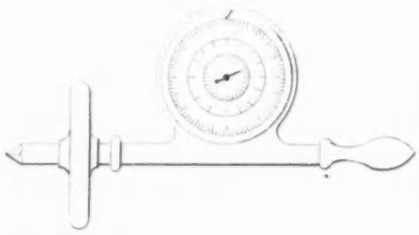
C. C. WALTON.

Birmingham, England.

Combination Speed Indicator and Watch

All who have had experience with a speed indicator know that it must be handled with care to get a correct record. This may be done by holding the instrument in one hand and a watch in the other, but it is difficult to give the indicator the attention it deserves and at the same time have an eye on the watch.

It has been my practice to call an assistant to hold the watch and call time, so that all I had to do was to hold the indicator in a proper position, apply it and remove it as directed by the timer. To dispense with this assistance I constructed the indicator illustrated herewith; its performance has been very satisfactory.



COMBINATION SPEED INDICATOR AND WATCH

At first sight the impression will be that the timepiece will so increase the cost as to prohibit the sale of the instrument. This need not be so, for a complete watch is retailed at $1, and the one used here is far simpler in construction; it runs a half hour without winding, has very few parts, and can be produced in lots at a cost not to exceed 50 cents each.

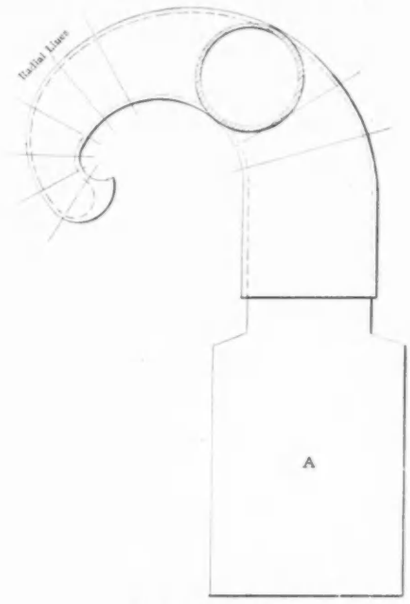
The rubber-tired wheel, shown on the spindle, will at once be recognized as a means for determining periphery speed.

Chattanooga, Tenn. QUICK.

Making a Crooked Pattern and Core Box

A job that seems simple at first sight often proves later to be a stumbling block of no mean proportions. This is particularly true in regard to the pattern shown in the accompanying sketch which will undoubtedly present some novel features to those unfamiliar with the type of pattern that this one represents.

As shown in the sketch, the job is a peculiar horn-shaped affair, with a circular section, and is to be cast in bronze. The metal is to be not more than ⅛ inch



A CROOKED PATTERN

in thickness. To insure uniform metal throughout, it can readily be seen that great care must be exercised so that the pattern and core box will be equally round at every point.

In order to mold easily the pattern must be split and doweled together. The curves are then laid out as per drawing and the pieces sawed to shape. In solving the problem of "rounding over" properly, the halves are separated and on the inside faces, radial lines are drawn dividing each half into numerous small sections. These lines are projected on the sides, and the thickness, corresponding to the radius of the circle at that point, is marked on them to be used as guides in obtaining the right thickness at each point. Having removed the surplus stock between these established points, the proper thickness is gained for the entire length.

With the aid of a spar rule in conjunction with these same radial lines, the amount of stock to be removed from the corners is determined; after which operation it becomes a comparatively simple matter to reduce the resulting octagonal form to the necessary circular one.

With a templet derived from the finished pattern, the core box is laid out and finished with the help of a triangle.

A represents the core print necessary to balance the core. This core print should be flattened on the nowel side, in all cases, to prevent the core from turning.

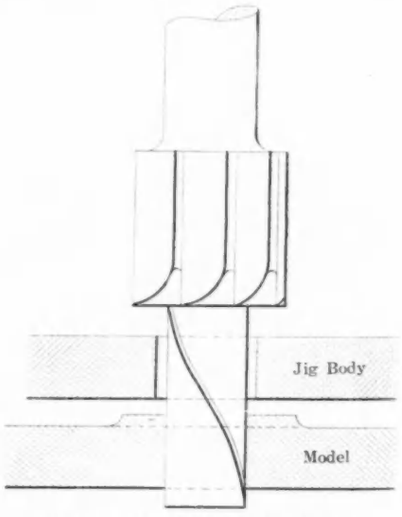
STEPHEN E. MCKEEL.

Cold Spring, N. Y.

Locating Holes in Jig with a Model

I have been greatly interested in the various articles published from time to time in these columns on the locating of holes in jigs and similar work, and consider them of inestimable value to all men engaged in toolmaking and designing, and especially so to the man who has grown fast to his home shop, and owing to that fact has been unable to get in touch with what other people are doing, except through papers like the AMERICAN MACHINIST.

There is one plan which I have not seen mentioned and which was used extensively a few years ago in one of the large plants, devoted exclusively to the manufacture of a light class of interchangeable machines, which is known all the world over. I advance this as a proof as to the usefulness and cheapness of the method. I



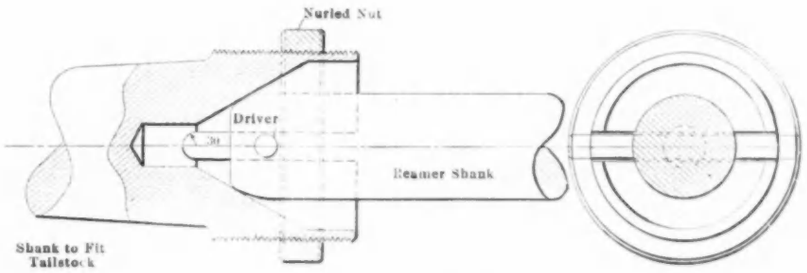
BORING JIG HOLES FROM A MODEL

don't say it is one of the most accurate, but it filled the bill where it was used, and its ease and rapidity recommend it. This method can also be used by a workman who perhaps does not possess the skill and ability to use some of the other methods.

Briefly the system is as follows: First and foremost, all the work is done to a perfect model, which is made up in the model or experimental department of the works, a blueprint being furnished by the tool-designing department giving the general outline and dimensions of the jig body. The body is finished up and fitted with feet, latches, clamps, etc., and the holes are laid out, but only as near as a scale measurement will bring them. The

model is now inserted in the jig, and fastened in place, just as the work would be.

The next move is to get a transfer counterbore of which a large number are kept in the tool crib, of all sizes suitable for the class of jig made up by the firm in question. The pilots of these counterbores are hardened, ground and lapped to various sizes, some standard and some to various decimal sizes in demand, and have also a spiral oil groove to enable them to be properly lubricated when running in the model piece.



A FLOATING REAMER HOLDER

The tool must be first-class in all respects, and be maintained in this condition; otherwise the system is no good. Also the holes in the model must be standard in their dimensions. I mention this because I have found in my own experience, with models from different departments, that they are not always close to standard.

The holes already laid out to scale or by some other quick, approximate method, are now drilled just a little larger than the pilot on the transfer counterbore; when this is done the pilot on the counterbore is carefully run down into the model piece in the jig, and the bushing hole in the lid or body counterbored out; the body size of counterbore, being of a suitable size for the outside diameter of the drill bushing which diameters should be standardized and the bushings held in stock, unhardened.

By this system the hole is located direct from the model, and if the drill press is in good condition a good job results.

I might add that this system was not the only one in use by this firm, it being used only on work in which the limits of accuracy made it permissible; on such work it was the quickest way I have seen.

Such work as master-plate hole locating was usually done on the miller, measuring over standard plugs inserted in the holes, and a standard in the milling-machine spindle, the measuring being done with micrometer or vernier, and sometimes with end-measuring rods and test pieces.

The holes were first spotted, then drilled, and then bored out to size by an adjustable boring tool (not a cutter in a bar), several of which have been described in the columns of the AMERICAN MACHINIST from time to time.

South Berkeley, Cal. W. L. WEBSTER.

A Floating Reamer Holder

We have had in use in our shop for some time a floating reamer holder, which, while not theoretically correct, is so near to it that it gives in actual practice very good results, and one holder holds a large range of reamers.

It is substantially a female center, having a shank to fit in the tail spindle of the lathe, or better still, having a shank bored to slip on to the tail spindle of the lathe, which removes any tendency to mutilate the taper hole. A slot is cut clear through from side to side of the holder forming driving surfaces for a pin, which is driven through the rear end of the reamer shank. This is prevented from dropping out or the reamer from hogging in, by the nurled coller, which is screwed on the outside of the holder. This may be set up tight against the pin if desired, which will make substantially a rigid holder.

By slackening the nut slightly and tilting the reamer shank, the reamer is readily removed.

The rear end of the reamer shank should be turned slightly spherical, although we do not see any difference in the results if we merely bevel the corner slightly.

We have made these of machine steel and case-hardened the inner surfaces.

Moline, Ill. W. P. HUNT.

Ring Oilers

That ring-oiling devices are not always to be depended upon was recently brought forcibly to my notice. In a large town in this district a large number of gas engines of moderate power have been taken out and their places filled with electric motors. In many instances these have been of the overhead type, and consequently less easy of access; in fact, it has been made a point of by the salesman that being out of reach they could not be meddled with.

In several instances the failure of the ring to work has caused the bearing to run hot, and this, being out of reach, has not been discovered until serious damage has been done. This has chiefly occurred in workshops where no proper electrician is employed, and where the man whose duty it is to attend to these things has other duties which must also be attended to.

In a recent case, where the repair gang from the job shop were called in, the ring would run when started by hand, but had stopped so often in the one place, Fig. 1,

FIG. 1

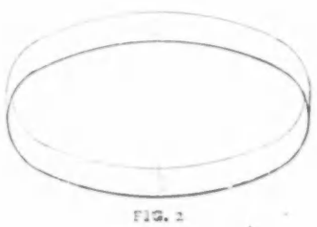


FIG. 2

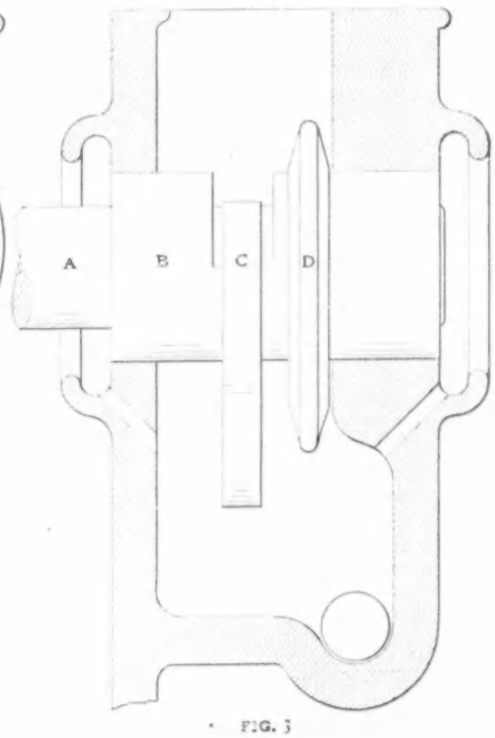


FIG. 3

RING OILERS

that it had become so badly worn that a new ring was a necessity. This looked like shutting down the shop and taking the motor apart to put in a new one. After a chat it was decided to make a new ring in two pieces, as shown in Fig. 2, with dovetail ends, and fix it up as an experiment.

The material was cold-rolled steel 0.375 inch wide by 0.062 inch thick, which happened to be on hand and also had round edges. Five minutes in the dinner hour was all the time taken to assemble it in position, the old worn white metal one simply being hung on the bearing at one side out of the way. This is shown in Fig. 3 ,where *A* is the shaft, *B* the brass bearing, *C* the new ring, and *D* the old one. Although only tried as an experiment, it has proved a very successful one.

WILFRID GEORGE.

Birmingham, England

Supporting a Gear Cutter Arbor in the Miller

We have had some trouble in our shop in cutting spiral gears with the outer end of the arbor, and the outboard bearing of the milling machine would often interfere with the index head the driving dog, etc.

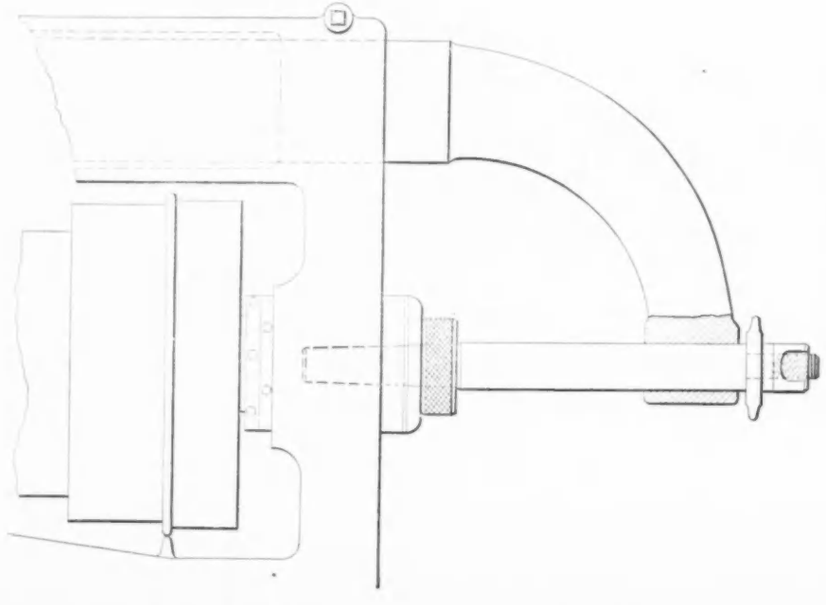
We at first overcame this by using a very long arbor and setting the outboard bearing away out. This was not very satisfactory, however, in heavy cutting, because it allowed so much spring, so we finally removed the bushing from the outboard bearing and made a comparatively short arbor with a bearing to fit the hole in the arm, putting the cutter directly outside of the bearing. This has given very good results, indeed, as it removes the bearing entirely out of the way and gives a very stiff support to the cutter.

We have been able to increase our feeds materially since adopting this device.

We were somewhat afraid of the wear when we put this in and expected soon to have to bore the bearing and bush it, but we have had it in about three years and there is no large amount of lost motion there yet.

The sketch indicates clearly the arrangement we use.

Moline, Ill. W. P. HUNT.



SUPPORTING A GEAR CUTTER ARBOR IN THE MILLER

Arbors for Holding Threaded Work in the Screw Machine

Quite frequently in screw-machine practice it is found necessary to hold a piece of work by a thread previously cut and to complete other operations on the work concentrically with the threaded part. The male and female screw arbors, shown by Figs. 1, 2, 3 and 4, are very satisfactory

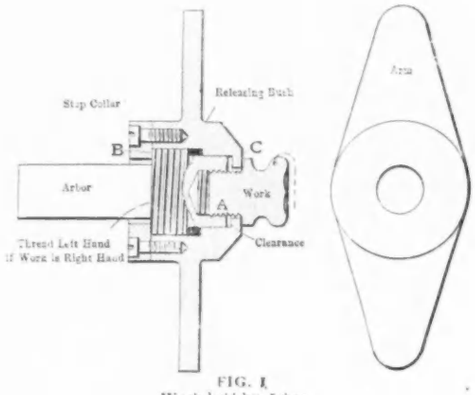


FIG. 1
Work held by Arbor

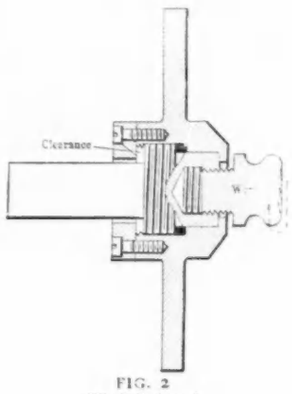


FIG. 2
Work Released

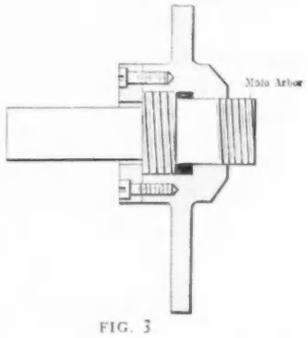


FIG. 3

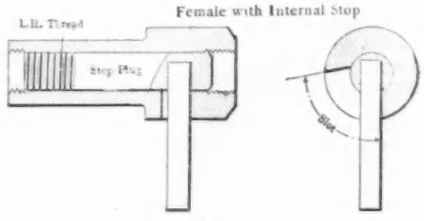


FIG. 4

ARBORS FOR HOLDING THREADED WORK IN THE SCREW MACHINE

for this purpose as positive-releasing action between the arbor and the shoulder on the work is obtained and thus no difficulty is met with in removing the work which does occur with the one piece threaded arbor.

Referring to Fig. 1, the arbor should be held tightly in the head spindle of the screw machine. The forward end at *A* is threaded right-hand, as shown. The large thread is left-hand. The releasing bush, with the spindle running in the direction of the arrow, is rotated so that the stop collar is against the shoulder *B*, thus carrying its front end *C* as far to the right as possible. The work should be screwed into the arbor with conditions as above noted, and ordinarily without stopping the spindle, the collar on the work being brought against *C*.

After the machine operations on the work have been completed, it is only necessary to reverse the spindle and to rotate the stop collar by lightly tapping the arm and thus cause the front end at

C to be withdrawn from contact with the shoulder on the work, as shown in Fig. 2.

Figs. 1 and 2 illustrate an arbor for work having male threads. Fig. 3 is of the same design, but for female work. Fig. 4 is for male-threaded work having no shoulder. Numerous modifications of these arbors obviously can be made to suit special conditions.

Hartford, Conn. C. L. GOODRICH.

A Fixture for Cutting Oil Channels in Bronze Bushings

We have, in the manufacture of our product, the proposition of making a considerable quantity of bronze bushings which vary in length from ⅞ to 3½ inches, and in diameter from 1 inch with a ¾-inch hole to ⅞ inch with a ⅝-inch hole, all of which have to be furnished with from one to three oil channels according to the demands of service. The demand for these supplies grew until we were putting a lot of time and money into hand-made oil channels; then we woke up.

The fixture is used in the shaper and consists of an angle plate *A*, Fig. 1, with a central rib *B* in which a ¼-inch groove is milled ½ inch deep for the reception of the formers *C*; these are made from ⅜x¼-inch cold-rolled steel, and case hardened.

The short side of the angle is bored out to receive the flanged bush *D*, and is faced to form a good bearing for the inner side of the flange. A pair of clamps *E e* are arranged on opposite sides of the bearing to secure it in adjusted position and are set tight enough to insure sufficient friction to prevent any chance of the work moving during the cutting stroke. The edge of the flange is provided with holes for a pin wrench and is also provided with clearly cut lines to enable the workman to index two or three equally spaced channels.

Interchangeable bushings *F*, Fig. 2, are provided to hold the various diameters of bearing bushes; these are furnished with a clamping bolt *G*, as shown, and bored out two or three thousandths larger than the finished size of the piece they are intended to hold. A small diameter portion of the bushes *F* fits the bore of the bush *D*, the threaded part draws it up to the shoulder and secures it against turning.

Fig. 3 shows a cutting tool holder which consists of a cutter bar *H* made of tool steel turned down to ½ inch on the business end for about 4 inches; this end is slotted to carry a ⅛x¼-inch tool, which is secured by a clamping bolt *I*, as shown. The other end is furnished with a roller *J*, which bears on the former *C* shown in Fig. 1. The cutter bar, roller, pins, etc., are hardened and tempered.

The cutter bar holder *K* is made of machinery steel and is slotted to receive the bar *H*, which is pivoted near the center and on the line of the cutting edge. A spring *L* and a stop screw *M* are provided to raise the cutter clear of the work when the roller reaches the ends of the former.

This simple and inexpensive fixture has proved to be entirely satisfactory and in addition to vastly cheapening the product, has improved the appearance of it. The disks *N*, shown in Fig. 1, are provided to square the fixture on the box table of the shaper.

Rochester, N. Y. L. W. G. FLINT.

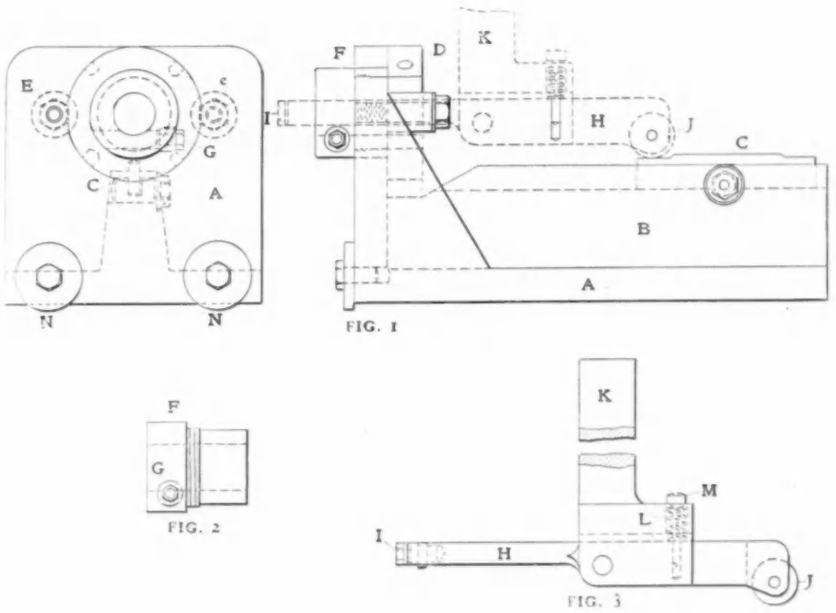


FIG. 1

FIG. 2

FIG. 3

FIXTURE FOR CUTTING OIL CHANNELS

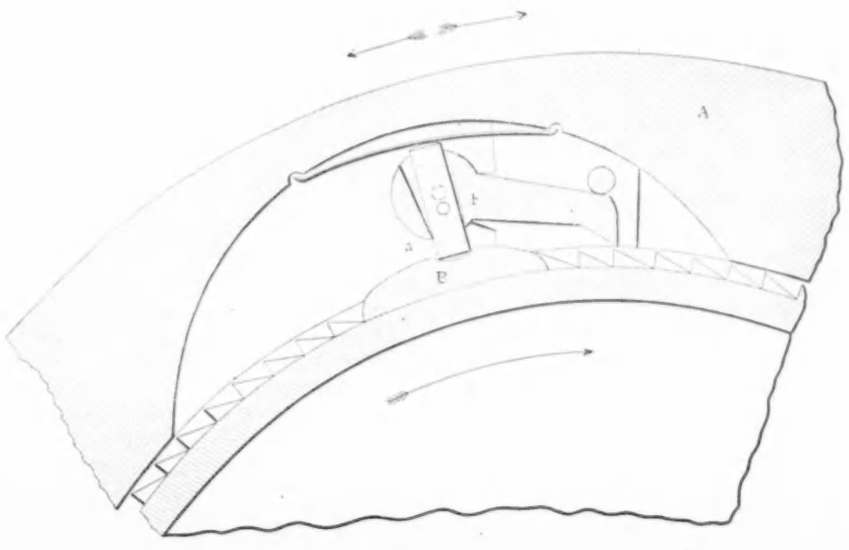
An Ingenious Design of Silent Pawl

In designing a machine where a ratchet and pawl seemed a good device, although objectionable on account of wear and noise, I devised a silent pawl, as shown by the line cut.

A wheel, part of which is shown at *A*, is given a variable back and forth motion, as indicated by the arrows. The friction piece *B* runs in a channel turned through the ratchet teeth, and is held by the spring and pin, and operates the pawl by alternately coming in contact first on one side and then the other of the conical hole at *a* and *b*.

Silent pawls are not new; but this appears to be a neater and quicker acting device than any I have ever seen or devised before.

Syracuse, N. Y. JOHN E. SWEET.



A SILENT PAWL

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Oct. 1..... 33,000

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The Aeroplane Disaster of September 17

While our leading article of this week was in course of preparation we were shocked to learn of the disaster to the Wright Brothers' aëroplane at Fort Meyer, Va., in which Lieutenant Selfridge, of the Signal Corps of the United States Army, was killed, and Orville Wright seriously injured. All great engineering developments seem to demand a toll of human life, and now the name of Selfridge has been added to that of Lillienthal and Pilcher as martyrs to the science of aërodynamics.

Expressions of sympathy were sent from all parts of the world and in this respect paralleled the messages sent to Count Zeppelin, following the destruction of his airship only a few weeks ago. There is another strong parallel in both of these disasters, for they occurred just as final success seemed within the grasp of their inventors. Count Zeppelin was ready for his flight to meet the specifications of the German government, and Orville Wright was preparing for the official trials before officers of the United States Army Signal Corps.

Such efforts and their results must not be belittled because final success was not achieved. True success is only achieved by the surmounting of many failures, and we hope for a speedy recovery on the part of Mr. Wright and a continuation of his experiments and trials, until he shall have carried aërial navigation many strides forward toward practicalization.

The accident emphasizes the greatest and most difficult problem now confronting the aëronautical engineer, the maintaining of stability. When this art of balancing, the art of bringing into coincidence the center of air pressure and the center of gravity of the machine, shall have been learned, great progress will have been made in aëro navigation.

New Supplies of Iron Ore

In connection with the agitation for the conservation of natural resources much has been said regarding the supposed impending exhaustion of the existing supplies of iron ore, this exhaustion having been placed in some estimates at as early a date as 30 years hence. At a time when alarmist reports of this character are gaining currency, the recent report of Dr. J. M. Clarke, State geologist of New York, disclosing new and entirely unsuspected deposits of iron ore, comes with singular appropriateness.

Under an appropriation made by the State Legislature of 1907, Dr. Clarke has conducted a series of diamond drillings across an extensive belt of territory in the central and western portions of the State which have discovered enormous deposits of iron ore carrying, according to conservative estimate, no less than 600,000,000 tons of mineable ore. These deposits extend westward from Otsego county to the Niagara river and their extent is such, according to the report, as "to make New York at once paramount in its iron wealth." The vastness of the deposits is best seen by comparing it with the output of the existing extensive mining operations in the Adirondacks, which up to the present time have produced no more than 5,000,000 tons—an amount which may be obtained from a single square mile of the newly discovered ore beds.

In addition to the positive discovery which it discloses, the report is even more suggestive by reason of the possibilities which it points out. Of course, the investigations of the State geologist are bounded by State lines, but, according to the report, the formation in which the ore is found occurs with its characteristic ore beds in Ohio, Kentucky, Indiana and Wisconsin and in many of the Southern States, attaining special prominence in Tennessee and Alabama, where these deposits are the main support of the enormous iron industries of the South. The ore beds are thus proven at their extremities, in Alabama by great existing workings and in New York by the diamond drillings. There is already a limited amount of iron mining done in Ohio, Indiana and Kentucky, but nothing in comparison with what the future holds in store should deposits exist in those States which are at all comparable with those now known to exist in New York.

Regardless of any consideration of this kind, it is obvious that with the discoveries which have been made known by these diamond drillings, all anxiety regarding our supply of iron ore for generations to come may be dismissed.

A. S. M. E. Meeting

The season of professional meetings of the American Society of Mechanical Engineers will be opened on Tuesday evening, October 13, by a meeting of the gas-power section in the Engineering Societies building, at 29 West Thirty-ninth street, New York.

H. L. Doherty, chairman of the meetings committee of the section, will present a report for discussion, outlining plans for future work, and there will also be a discussion of standards to be used in gas-power work.

Two papers will be read, one by E. A. Harvey, on gas-producer plants, with data upon costs, performance, etc., and one by N. T. Harrington, giving the results of tests to determine the loss of fuel weight in a freshly charged producer, due to increase of ash contents in the fuel bed. The first paper will be illustrated by lantern slides, showing actual plants and plans for the arrangement of apparatus.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Universal Horizontal Boring Machine

The boring machine recently brought out by the Universal Boring Machine Company, Hudson, Mass., is of the type with movable spindle and stationary work so far as vertical movement is concerned. The outer bearing is kept in line by a screw driven by spiral gears. The bed, or box section, is heavy in all necessary details, has feed and speed boxes designed to be removed as units and is otherwise in keeping with modern practice, both as to materials and workmanship. The machine has all geared spindle speeds, sixteen being readily obtained by the speed box shown in the lower half of the box at the head end of the machine, and in detail in Fig. 3. By the use of nine gears and a segment gear having two studs, one above and one below its pivoting point, and a rocker gear operated by hand lever, eight speeds are obtained. Four gears are keyed together and slide on the constant-speed shaft. One gear runs on the upper stud on the segment gear and this meshes with the gear on the shaft which runs through the center of the segment mentioned. On the lower stud on this same segment are two gears keyed together and one of these gears meshes with the largest spur gear that is on the shaft that runs through the segment gear. By rocking this segment either way one speed is obtained by meshing first the upper gear with one of the four on the constant-speed shaft, and by meshing the lower gear on the segment with the same one of the set of four, the four gears being set at the same position, gives another speed and thus by shifting the set on the constant-speed shaft, four different positions, and rocking the segment, eight speeds are obtained. These speeds are doubled at the head which gives sixteen spindle speeds with the use of these gears, ranging from 15 to 200 revolutions per minute with a speed of 230 at the constant-speed shaft below.

A tight and loose pulley is used, the loose pulley being designed to run from eighteen or twenty months with one oiling

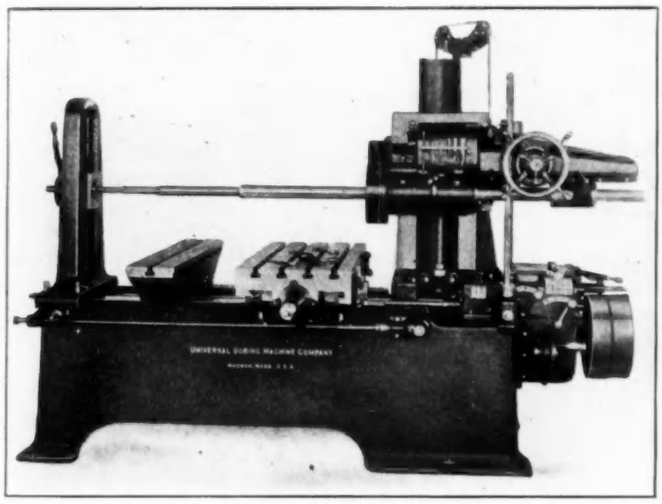


FIG. 1. THE UNIVERSAL BORING MACHINE

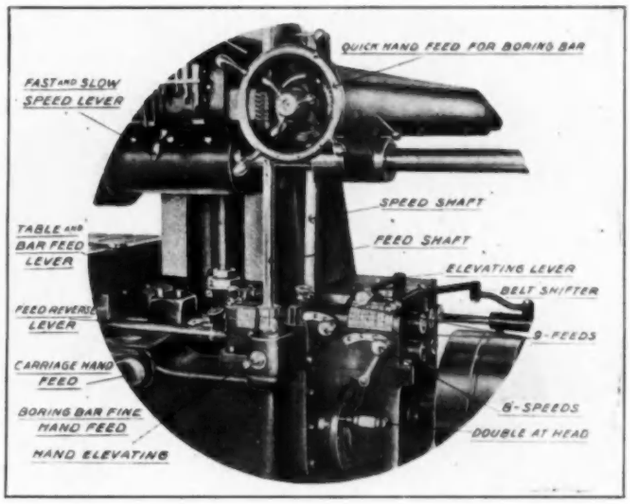


FIG. 2. THE CONTROLLING LEVERS

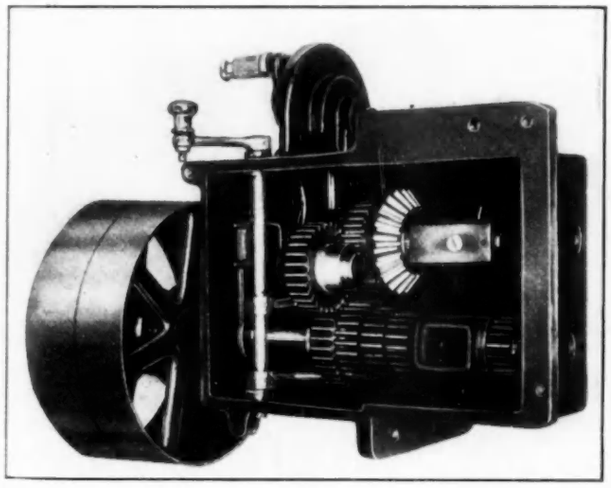


FIG. 3. THE SPEED BOX

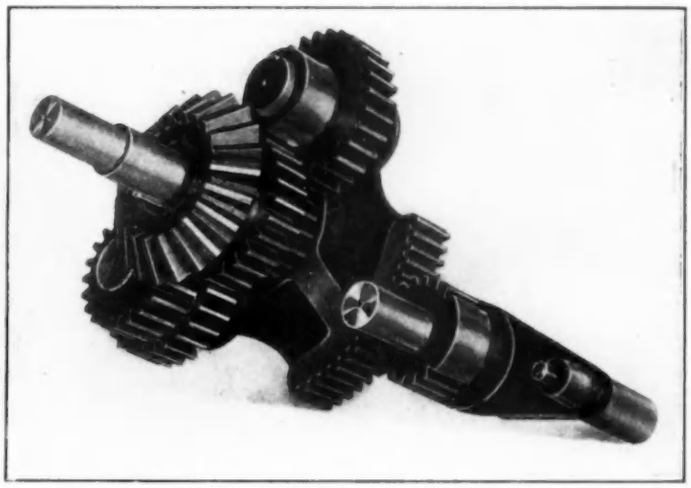


FIG. 4. THE TUMBLER SHAFT

due to the reservoir cast in the hub, which is filled with cotton waste and wicking run through the bearing. The machine has power feeds for all motions, that is, the table or cross-feeds, the head vertical feed and the boring-bar feed, all of which are regulated by two feed levers, and the feeds of these are all constant, no matter what the spindle speed may be. These range from ¾ to 5½ inches feed per minute. With this design nine feeds are obtained with each spindle speed. All feeds are reversed with the same lever and the motions of those feeds bear the same relation to each other. With the reverse lever down, the head feeds up, the table feeds away from the operator and the boring bar feeds toward the outer bearing support post. The head also has one fast up and down travel which enables the boring bar to be brought to a point by power in addition to the hand adjustment.

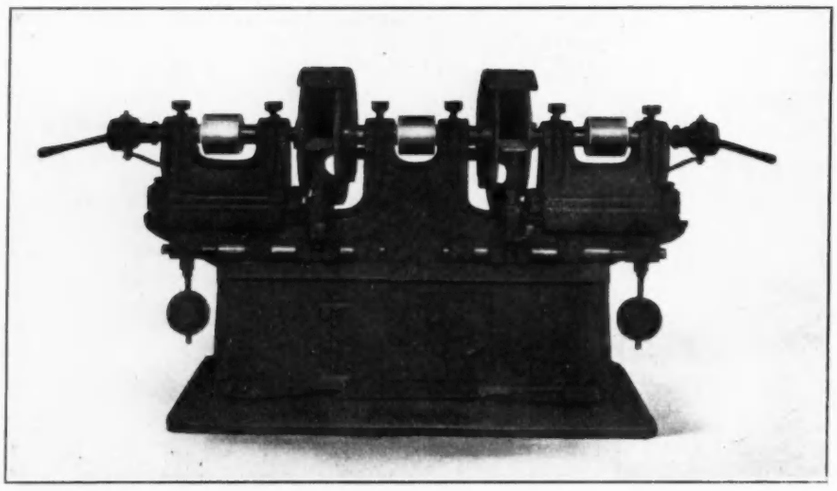
On one of the bearing surfaces which the head moves on, is a scale graduated and marked in inches, the first mark being 0 to indicate the point when the center of the spindle is at a line with the top of the table. With these graduations it is possible to stop the moving of the head within ⅛ inch of the point required. Then by bringing the dial to its proper reading it is easy to get the necessary distance.

The boring bar is able to feed 27 inches and can be reset by a clamped bearing so that 54 inches of travel might be had. The hand wheel is set at a point most convenient for the operating and setting of boring bars and allows the operator to be close to his work and within easy reach of the feed friction or hand wheel.

The machine has its head at the right-hand end of the machine. The driving of the spindle is at the point nearest where the work is being done. On the face of the spindle, provisions are made to bolt or fasten cutter usually used on heavy milling machines.

A Grinder with Four Disks

This is a new type of grinder and, as will be seen, combines two double-disk machines by the use of a central stationary head and a sliding head at each end. Such a combination is especially useful in what might be called "two-stage" grinding, in which the first or roughing operation is done between one pair of disks and the finishing between the other.



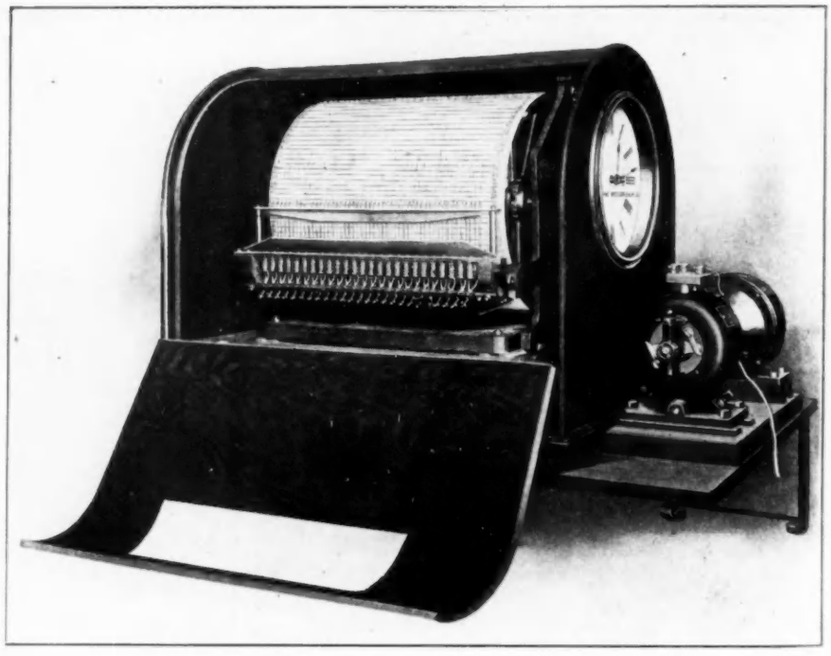
A FOUR DISK GRINDER

In such a case two operators are employed and the work passed from one to the other. While originally designed for disk grinding, a chuck for holding an emery ring may be substituted if heavy grinding is to be done, such as in the roughing end.

Both driving heads swivel and can be clamped at any angle up to 10 degrees so that both sides of any angle within this range can be ground at one setting. Either head can be moved back to accommodate work of any length up to 12 inches, or can be entirely removed so as to make one end a regular single-disk grinder. The disks can be brought up to the work either by hand or foot power, or a combination of both if necessary. As the heads are counterweighted it does not interfere with the regular hand operating device in the least. As can be seen, the grinding rests can be swung in between the wheels or can be locked stationary, as preferred. This is known as the 6-A-4 Gorton grinder and is made by the Diamond Machine Company, Providence, R. I.

Recording the Working Time of Machine Tools

This machine has been designed to show the actual working time of any or all machines in a shop so as to give an accurate record of the cost of production. It is to show whether the machine has been working its full quota of hours and if so to see if the output is in accordance with the rate set. After the time for handling work in and out of the machine is determined, it is easy to see whether it has been left running idle or not during the day.



RECORDER FOR THE RUNNING TIME OF TOOLS

The machine consists of a horizontal drum rotated on a shaft and driven by a large spring, the speed of the drum being regulated by a clock movement. This drum is 18 inches in width and has clamped on its face a sheet of chemically prepared paper and is ruled so as to show

the time, each line representing a minute. The chart is ruled so as to give a record of 50 machines at one time, each machine being represented by a number from 1 to 50 at the top of the chart. A frame in front of the drum carries a row of 50 metallic points or markers, each point being connected electrically with one of the shop machines.

The connection is made with the shipper or belt-shifting lever by which the machine is started or stopped or at any point upon the machine which indicates production, such as the feeds on a lathe, the lever on a drill press, or the spring on a sticking machine. When the machine is started, the circuit is closed bringing the corresponding marker of the recording apparatus in contact with the sheet on the revolving drum. This contact continues until the machine is stopped so that a line is drawn, showing the length of time the machine has been producing. When the machine has stopped or when the work has ceased being put through the machine, the circuit is broken and the marker withdrawn from the paper, thus showing a blank space until the machine is again started.

The records can be arranged to suit the conditions, and certain forms have the lower part perforated so that the total for the day can be torn off for the works' manager, enabling him to see at a glance just how many hours the machines have been working during the day.

They are intended to assist in setting piece rates and also in verifying them at any time. The machines are built by the National Machine Recorder Company, Marquette building, Chicago, Ill.

A 15-inch Crank Shaper

This machine has been built to meet the demand for shapers capable of using high-speed tools and of withstanding the cuts which they can carry. The column is unusually deep and is reinforced to insure rigidity, while the projection of the ways both front and back gives a long bearing for the ram.

Among the interesting tests made by the builders we take the following, the first on cast iron, the second on steel.

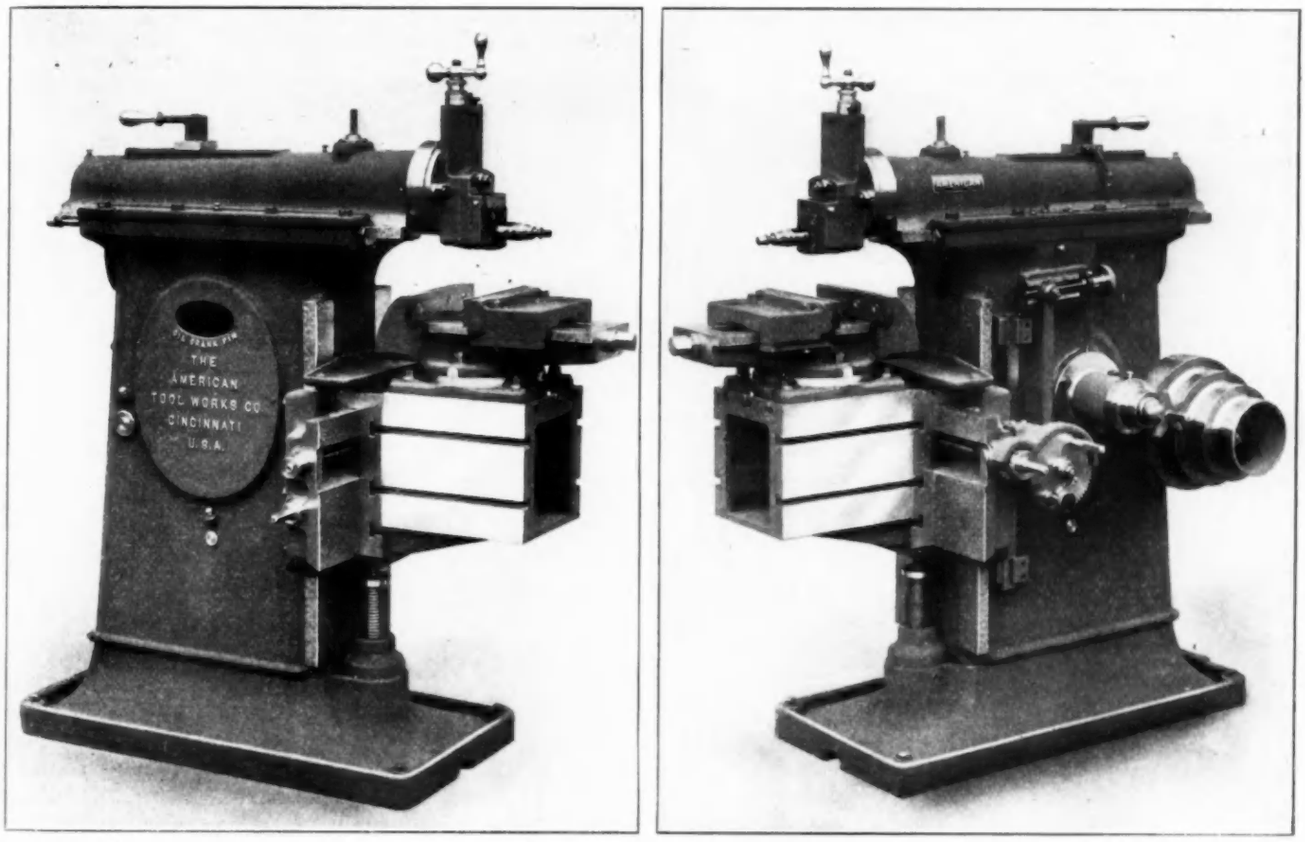
¼" deep, 0.016 feed	4 inches long, second slow cone step.
¼" deep, 0.040 feed	4 inches long, second slow cone step.
¼" deep, 0.048 feed	4 inches long, second slow cone step.
¼" deep, 0.024 feed	12 inches long, first slow cone step.
¼" deep, 0.016 feed	2½ inches long, second slow step.
¼" deep, 0.016 feed	10 inches long, first slow step.

The ram has a continuous taper gib with end adjustment for taking up wear. Its stroke is positive and it has four rates of speed ranging from twenty to sixty-five strokes per minute. The length of stroke can be changed without stopping the machine and the crank handle near the head allows the ram to be positioned while in motion. An indicator shows the stroke at all times.

The head can be operated at an angle within an arc of 100 degrees, has a continuous taper gib on the downslide, has large tool posts for holders with inserted cutters and a down feed of unusual length. The table and apron are both designed to have large wearing surfaces, and for rigidity to withstand heavy cuts. The cross-rail is of box sections, is strongly ribbed, is made long and has wide bearing surfaces. It is also provided with a telescopic elevating screw.

The cross-feed is of new design, can be varied at will and is automatic with a range of from 0.008 to 0.200 inch, all variations being instantly attained while the machine is running. The nurled knobs shown control the rate of speed which can be read from the graduation, each notch representing 0.008 inch.

To allow key seating the rocker arm is made of double sections at the top so as to permit a shaft 2½ inches in diameter passing clear under the ram. The vise is of new design and of very heavy pattern. It is clamped by two bolts to the swivel base which is graduated in degrees and covers nearly the entire top of the table. Special attention has been paid to complete lubrication of all working parts, the ram slides are provided with wipers and there is an oil pocket cast in the column for storing any surplus of oil. There is



TWO VIEWS OF A NEW 15-INCH SHAPER

also a pocket in the arm from which the crank pin and sliding block are lubricated. This shaper is built by the American Tool Works Company, Cincinnati, Ohio.

Constant Speed Drive Applied to a Screw Machine

The illustration shows an application of the constant-speed drive to an automatic screw machine, a No. 2G of the Brown & Sharpe Manufacturing Company, Providence, R. I., and is believed to be the first case of its kind. The machine itself is practically unchanged, the new features being detailed in Fig. 2.

A friction clutch is located in the driving pulley *A*, allowing the machine to be driven direct from the main line, eliminating the complicated overhead works, and dispensing with a large amount of belting. Any standard constant-speed motor can be mounted upon the machine, thus making the installation unusually self-contained.

The spindle is driven by silent running chains combining high speed and efficiency. Variations of the spindle speeds are obtained by means of change gears and friction clutches, each pair of change gears giving two spindle speeds (one slow and one fast, automatically changed by the friction clutches). There is also a friction clutch located on the spindle for reversing, so that with the whole combination, it is possible to obtain twelve forward changes and twelve backward changes of speed for the spindle.

The feed-driving mechanism is positively connected with the spindle-driving mechanism, a feature which will undoubtedly be appreciated. The power is taken by the driving pulley *A*, to which the sliding gear *B* is connected by a friction clutch. By means of this friction clutch the machine is started or stopped, and there is, in addition, independent means provided for starting and stopping the feed when desired.

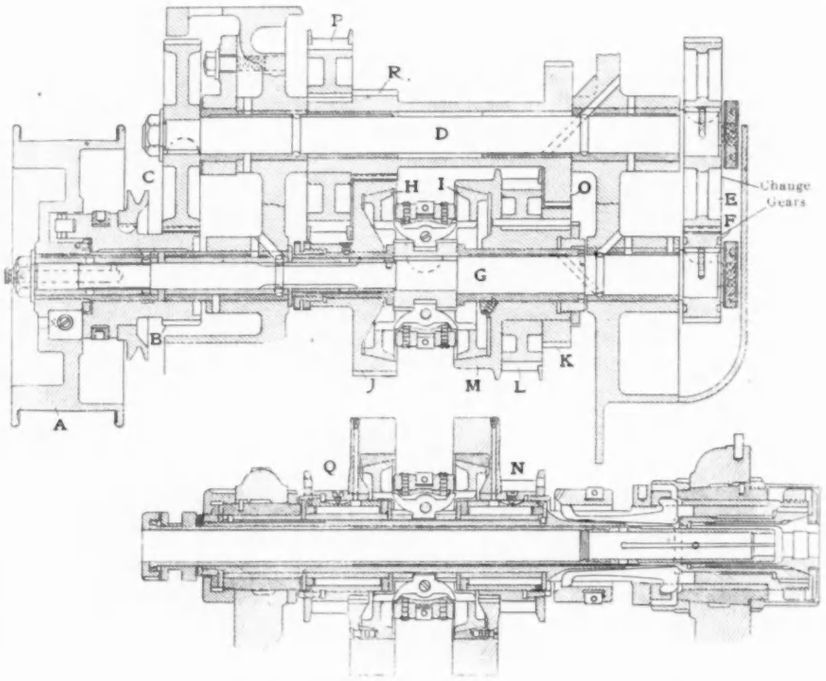


FIG. 2. DETAILS OF THE CONSTANT-SPEED DRIVE

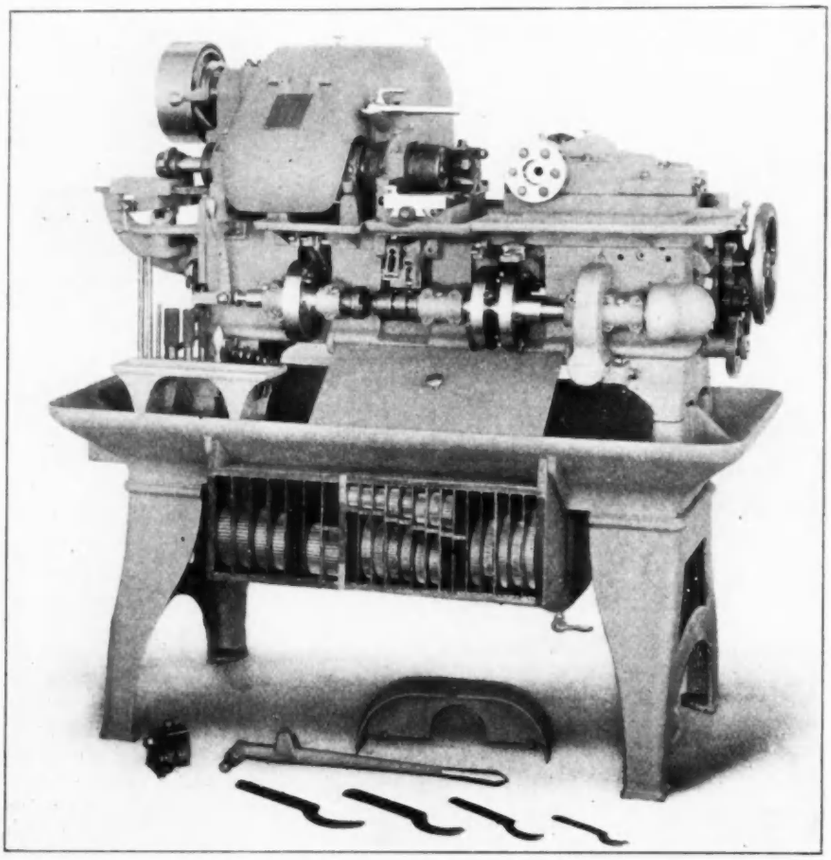


FIG. 1. AUTOMATIC SCREW MACHINE WITH CONSTANT-SPEED DRIVE

The sliding gear *B* through gear *C* drives the back shaft *D*, which in turn drives the clutch shaft *G* through the change gears *E* and *F*. Keyed to the shaft *G* is the friction body with faces *H* and *I*, and mounted loosely on shaft *G* is the gear *J* on one side of the friction

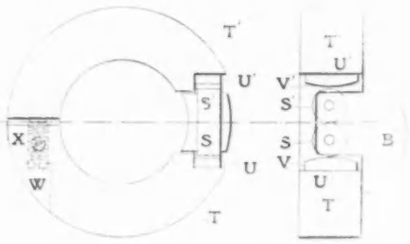


FIG. 3. DETAILS OF CLUTCH

body and on the other side of the body the gear *K* and chain sprocket *L*, both of which are fastened to the friction back *M*.

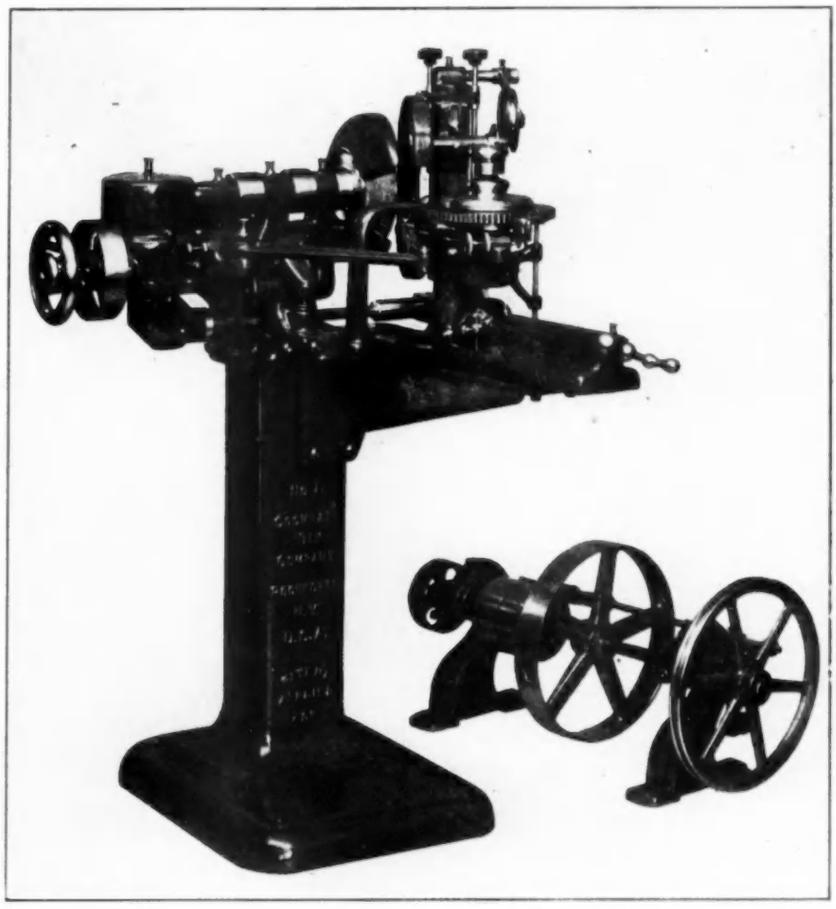
Mounted loosely on shaft *D* is a quill on which are the gears *O* and *B* and the sprocket P^1. When the clutch-face *I* engages the friction back *M*, the spindle is driven back at a slow speed through the sprocket *L*, and the chain and sprocket *N* and spindle is driven forward at a slow speed through gears *K* and *O*, the sprocket *P*, and chain and sprocket *Q*. When the clutch face *H* engages the gear *J*, the spindle is driven forward at a fast speed through gear *B*, the sprocket *P* and

the chain and sprocket Q, and is driven backward at a fast speed through gears R, O and K, the sprocket L and chain and sprocket N.

The direction of the spindle depends upon whether the clutch body on the spindle is engaged with sprocket N or sprocket Q, both of which are loose on the spindle and are provided with roller bearings. All bearings in the driving mechanism are well bushed with bronze and oiled from pockets on the outside of the case.

The friction clutch in the machine driving pulley is entirely new in design and differs greatly from the usual type of friction employed for this purpose. The driving pulley A carries a split friction ring T and T^1, which is expanded by the two hardened rolls S and S^1 on the end of the sliding gear B. These rolls operate against the hardened shoes U and U^1, the inner surfaces of which are arcs of circles. The sliding gear B is operated by a conveniently located hand lever.

To operate the friction, the rolls are forced in between the shoes a little beyond the centers of the arcs, thus expanding the ring and clamping it to the pulley. As the rolls are beyond the centers of the arcs, they remain locked in position. To compensate for wear, the friction ring is adjusted by the screw W, and clamped by the set screw X.



GRINDER FOR COCHRANE-BLY COLD SAW

Grinder for Cold Metal Saw

This machine has been devised by the Cochrane-Bly Company, Rochester, N. Y., to grind the special teeth used in their saws, and before describing the machine it may be well to see just what it has to do. Fig. 1 shows the proportions of the teeth, and it will be noted that every other tooth is ground so as to have only about one-third the full cutting width of the saw. This tooth is also left higher than the others so as to act as a roughing tool in the center and then to finish with the broad, square, cutting tooth.

The saw blade is mounted on a spindle with an index plate of the same number of teeth as the saw; the grinding-wheel spindle is carried by a swinging frame, operated by cams and levers, which give it two movements; one feeds the wheel toward the center of the saw, grinding the face of the tooth, after which the wheel backs out and is fed across the top of the tooth to grind the land. The frame is, of course, set to give the proper angle to the tooth on each of these faces, and, as the feed movements start at the point of the tooth it leaves the cutting edge sharp and free from burs.

The cams are so arranged that in grinding the top, or land, of the tooth, every alternate one is ground about 0.012 inch lower, and while the grinding wheel is working on the high tooth, the two bevel-

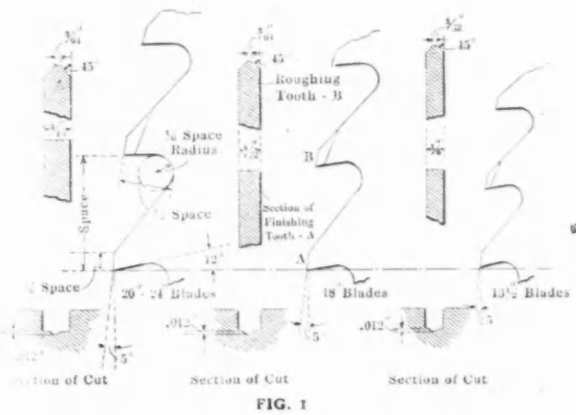


FIG. 1

THE TOOTH AND ITS CUT

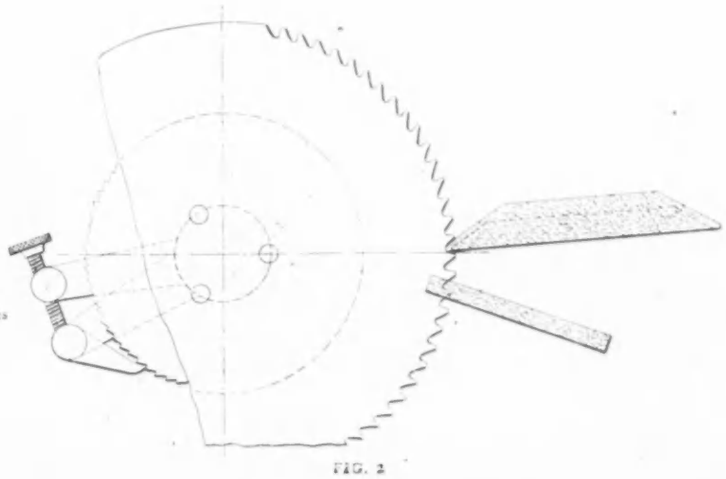


FIG. 2

GRINDING ON TWO TEETH AT ONCE

ing wheels are grinding the sides of the next high tooth back, as seen in Fig. 2, the beveling wheels resting while the grinding wheel is working on the low tooth. After a tooth has been ground, the saw is indexed by means of an index lever operated by a cam, each tooth being brought up to a certain fixed point, insuring even spacing.

The spindle carrying the saw and index plate, is set in a slide mounted on a bracket attached to the frame of the machine; this slide is adjusted by a handscrew along the bracket to accommodate various size saws. An adjustable automatic feed is provided for feeding the blade toward the wheels, after it has been indexed once around, and the blade will continue to feed in after each revolution, until the required amount of stock has been removed.

A special saucer-shaped wheel is used, which keeps its shape as it is worn down, and does not require dressing to produce the proper form of tooth. The cam movement of the machine governs the shape of tooth. All bearings have been protected by covers and felt washers, in the effort to make the machine very durable; all spindles are hardened and ground, and the No. 11 machine will grind saws from 10 to 24 inches in diameter.

A Planer With Four Cutting Speeds

In this planer the designer has placed all his gearing inside the bed so as to secure a rigid support, to get them out of the way and to protect them at the same time. The illustrations show a 24x24 planer and the details in Fig. 2 show how the four changes of speed are accomplished. These changes give cutting speeds of 20, 25½, 32 and 40 feet per minute, and a return speed of 80 feet per minute with a single-speed countershaft and the number of changes can easily be doubled if desired by the usual two-speed counter, although it would seldom be required.

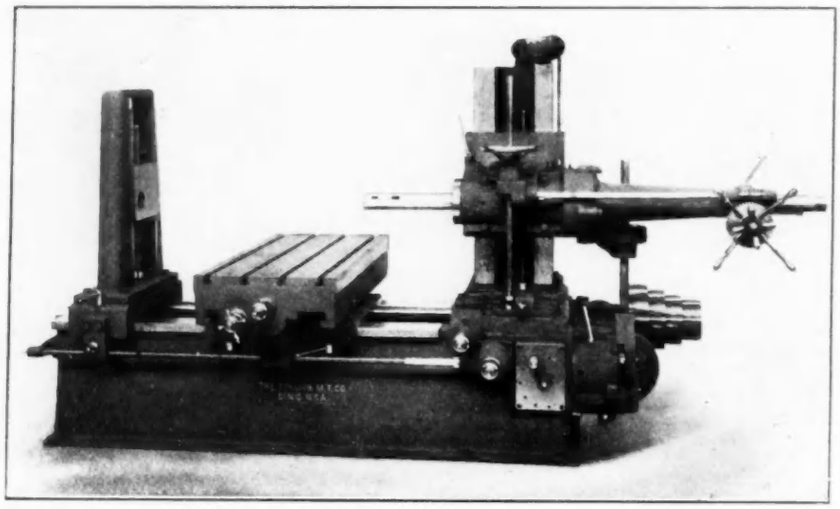
Four pairs of gears, so arranged that only one pair are engaged at the same time, give the eight changes, being controlled by two levers in such a way that it is impossible to throw in conflicting gears and avoiding danger of accidental damage. No clutches are used, the gears being moved into direct contact before the planer is started, there being almost no need to change while running as in a lathe where the cutting speed changes as the diameter varies.

The gears are all of steel, have wide face and coarse pitch and are built for heavy work. The first speed-changing shaft is driven by a rawhide gear and as they all run at a comparatively slow speed the noise and wear is reduced to a low point. An index plate shows the different speeds and the whole arrangement is very simple and compact.

It is made by the Hamilton Machine Tool Company, Hamilton, Ohio, and can be furnished on all sizes of spur-gear planers, or can be arranged for motor drive when desired.

Fosdick Horizontal Boring Machine

This is a boring machine of the type having a stationary bed and movable bar, with the outboard bearing moving in unison with the spindle. The spindle travel is 22 inches, the vertical movement 21 inches, while the table moves laterally 36 inches and 28 inches across. The maximum distance from spindle to outboard bearing is 60 inches, or it can be removed for larger work. All movements can be made by power and all have micrometer adjustments. The table is 23½x50½, has four T-slots and six stop holes.



HORIZONTAL BORING MACHINE

The spindle is of crucible steel, 3 inches in diameter in the driving sleeve and 1½ inches at the rear. It has ball-thrust bearings and fitted with a No. 5 Morse taper with cotter key. Provision is made for maintaining alinement at all times.

All drives are positive including two mechanical speed changes with clutches. A 3-inch belt is used either on a cone- or constant-drive pulley. There are 8 spindle speeds ranging from 12½ to 155 per min-

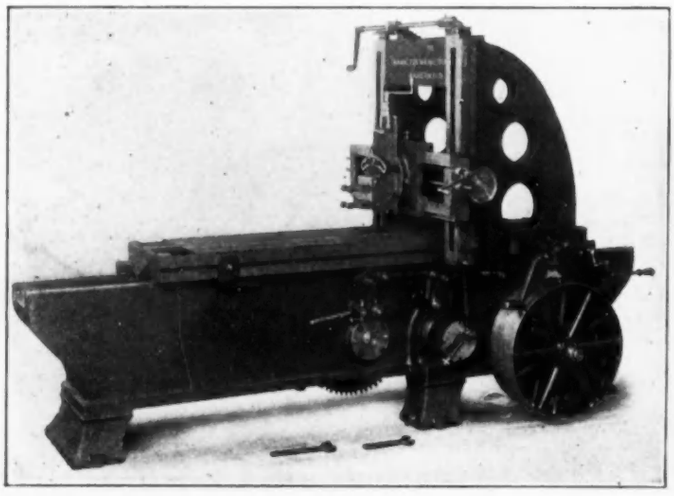


FIG. 1. A VARIABLE SPEED PLANER

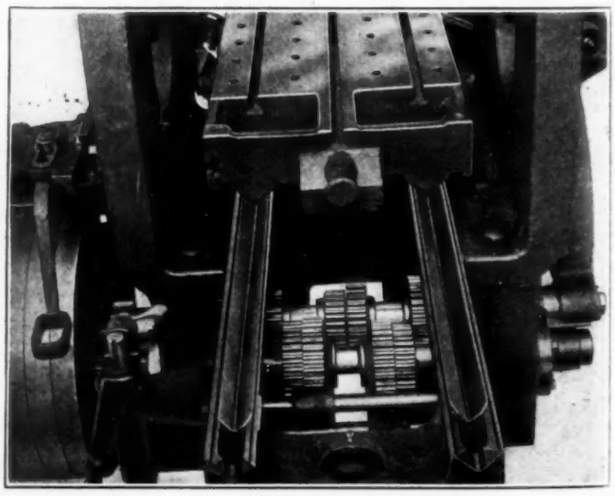


FIG. 2. THE SPEED CHANGING GEARS

ute and all are reversible. The feed changes range from 0.007 to ¼ inch per revolution, with 6 steps in between the feeds named. Motor-driven machines can be either constant speed through a gear box or with a variable 3 to 1 motor as desired, a 5 horsepower being recommended in either case.

It is built by the Fosdick Machine Tool Company, Cincinnati, Ohio.

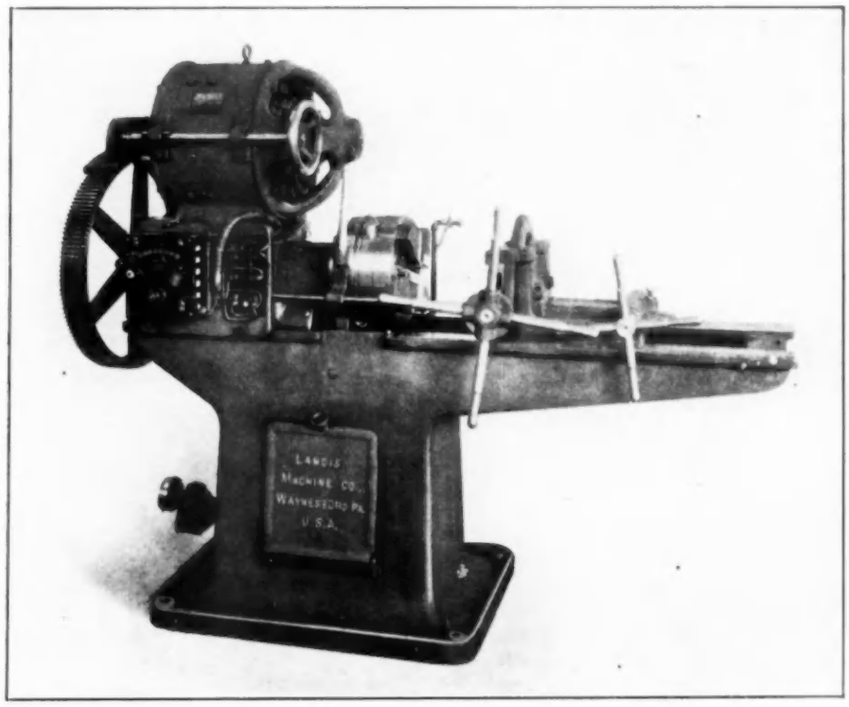
New All Steel Die Head

The accompanying illustrations show the details of the new all steel die head used in the bolt-cutting machine of the Landis Machine Company, Waynesboro, Penn. While the general appearance is somewhat similar to their older machines, there are a number of new details which make it more substantial than before.

The chaser holders *A* shown in Figs. 1, 3 and 6, carry the chasers and are pivoted at *X* on the face of the die head. Details of the way in which the chasers are clamped can be seen at *M*, Fig. 6, and the method of opening the chasers is by revolving the ring *R*, which controls the outer end of the chaser holders by means of the sliding blocks *C* in Figs. 1 and 3.

Referring to Fig. 2, we see the two cone pointed pins which bring the rings *R* back into position after it has been moved to release the work and these insure the chasers being brought back to their original position, which maintains the correct diameter of the thread at all times. A positive release is obtained by use of springs *F* shown in Fig. 3, the ends of these being connected to the chaser holder and giving a positive opening movement as soon as the die is released.

The unlocking ring *H* is operated either by an automatic trip or by hand, and pulls the wedge *G* against the incline on the locking bolt *F*, raising it and allowing the springs *L* to separate the part of the die head at *U*, drawing the cone locking pins out of their hardened-steel bushings enough to allow a sufficient movement of



MOTOR-DRIVEN BOLT CUTTER

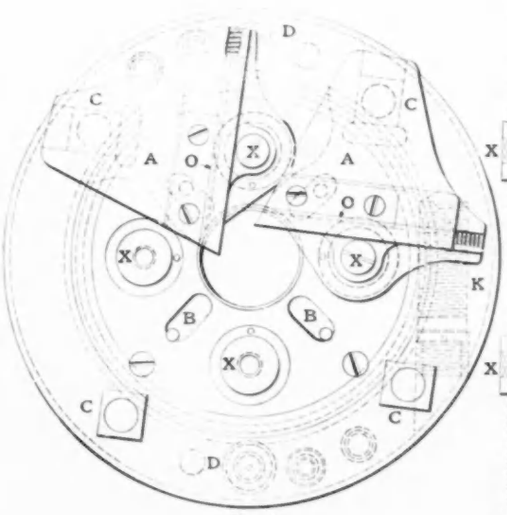


FIG. 1

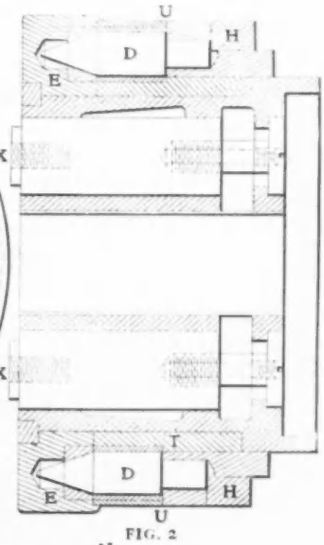


FIG. 2

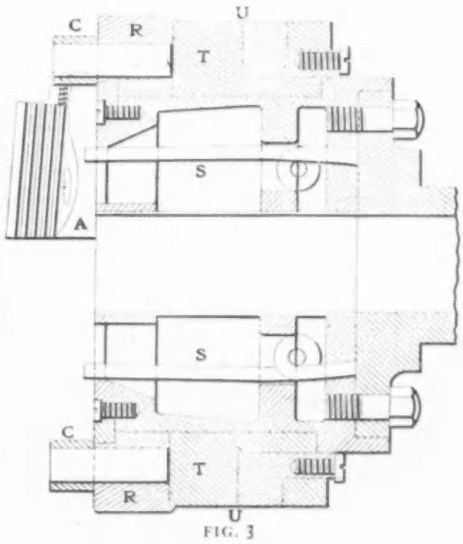


FIG. 3

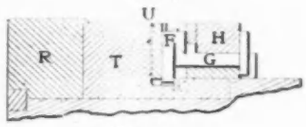


FIG. 4

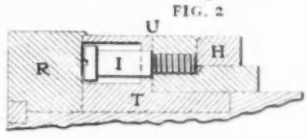


FIG. 5

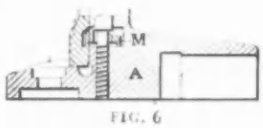


FIG. 6

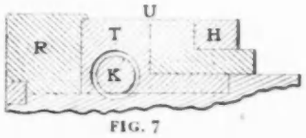


FIG. 7

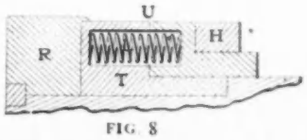


FIG. 8

DETAILS OF THE LANDIS ALL STEEL DIE HEAD

the rings *K* to give all the opening necessary with the chasers. The screws *I*, Fig. 5, limit the amount of this movement. This makes a very compact die head having large wearing surfaces at all points, at the same time maintaining all the advantageous features of this method of cutting bolt threads.

For adjusting the chasers through different diameters, they are first set by a gage so that the cutting points come at an equal and specified distance from an index mark on the holder. Then the central ring *T* is adjusted around the body by means of the screw *K* acting in a worm, which is cut around the outside of the inner body, as indicated in Figs. 1, 2 and 7.

To those who are not familiar with the workings of a die having this kind of a chaser, it is extremely interesting to see how they maintain the pitch without a lead screw, even when the dies are forced on stock which is considerably larger than the outside diameter of the thread cut. In this case the front edge of the die simply acts as a hollow mill and after the thread is started it will maintain the correct pitch under very trying circumstances, in spite of the fact that no lead screw is used and that all the guiding or following depends upon the chasers themselves.

Lathe and Planer Tool-holder

The tool holder shown is almost self-explanatory. The body has a dovetail at the front end for the inserted tool, and is split to give spring for being drawn together by the bolt. This bolt is nearly all in the body, but projects into the dovetail opening enough to engage in one of the grooves shown at the back of the cutter. This makes a positive stop for the cutting tool and holds it very rigidly.

The bolt is also flattened on one side so that the tool can be set at any point between the grooves and held by clamping only. These holders are made large for railroad and other shops handling heavy work, and a chip sent us shows that it can stand up under extremely heavy cuts. It is made by the G. R. Lang Company, Meadville, Penn.

Surface Grinding Machine

This was designed especially for die-makers, but is also suitable for any plain surface grinding within its capacity. It

SMALL SURFACE GRINDER

carries an 8-inch wheel, which can be located at any desired point on the arbor.

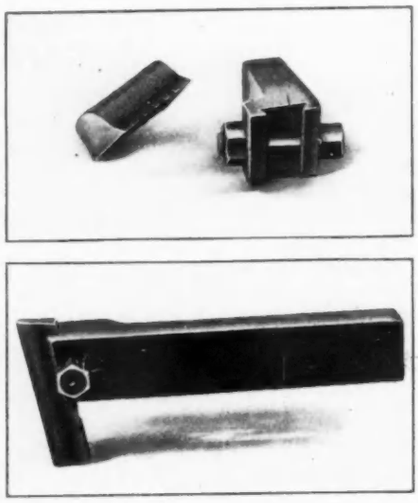
It will grind to the center of a 24-inch circle; the table is 18x25 inches, and grooved to catch the loose emery. The table elevation can be controlled by the screw beneath and has a graduated collar. The spindle is of crucible steel; the front bearing is taper, and end play taken up by hardened and ground split collar. The bushing at outer end is made of phosphor bronze and is adjustable for wear. It weighs 500 pounds. The maker is Wm. P. Stein & Co., Rochester, N. Y.

Cone-driven Schellenbach Lathe

A cone-driven lathe, similar in other respects to the geared-head Schellenbach lathe recently illustrated in these columns, has been brought out by the John B. Morris Foundry Company, Cincinnati, Ohio.

The drive is arranged direct into the face plate as is the case with their geared-head machine, as shown in Fig. 2. The spindle *A* has a flange at its right end and receives the face gear *B* which is doweled and screwed to it. This face gear *B* has internal threads and receives the face plates or the chuck. It will be seen that the chuck plate *C* fits the counterbore of the chuck and is bored to fit the end of the spindle and threaded on the outside to screw into the face gear *B*. When the pressure is exerted against the chuck, it will be seen that it clamps the flange of the spindle tightly between the chuck plate *C* and the face gear *B*. Clutch teeth *D* are formed upon the spindle and engage the clutch *E*, which is splined to the cone pinion sleeve *G*. This clutch is operated at the back end of the headstock by a spring-seated plunger which passes through the cone pulley. The plunger is provided with a nurl with a detent pin in it for holding it out of engagement.

The head shown has a three-step cone, the largest diameter being 12 inches for 3-inch double belt, and there are two changes of back gearing, making in all nine changes of speed with a single speed of the countershaft. The countershaft, however, is provided with double friction pulleys, and where back motion is not needed, it may be driven at two different speeds, thus giving the spindle



INSERTED TOOL HOLDER

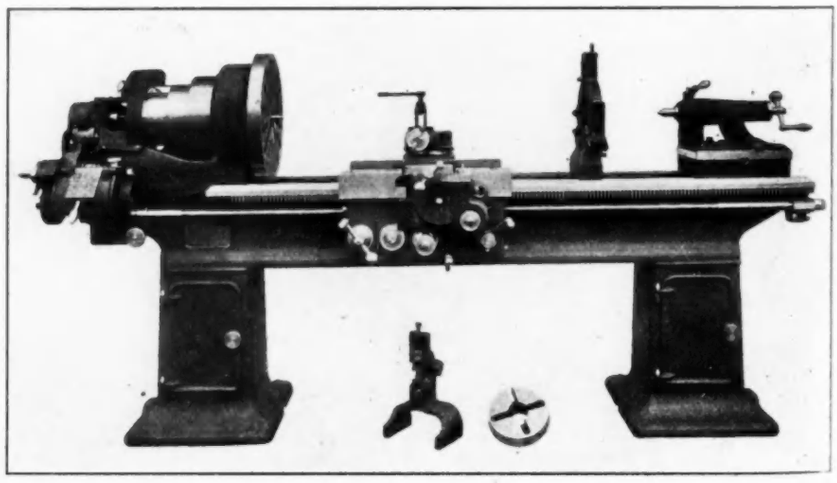


FIG. 1. CONE-DRIVEN SCHELLENBACH LATHE

six open-belt speeds and twelve back-gear speeds. The back gear is operated with the eccentric shaft in the ordinary manner. It will be noticed that the overhang of the chuck, from the face of the jaws to the front spindle bearing, is not so great as with the ordinary type of lathe. All of the gearing on the head is of coarse pitch and is inclosed.

This lathe is provided with a quick-change device, giving a range of threads from 2 to 112. It has a double plate apron and a special feature for rough-chasing threads by the ordinary rack feed

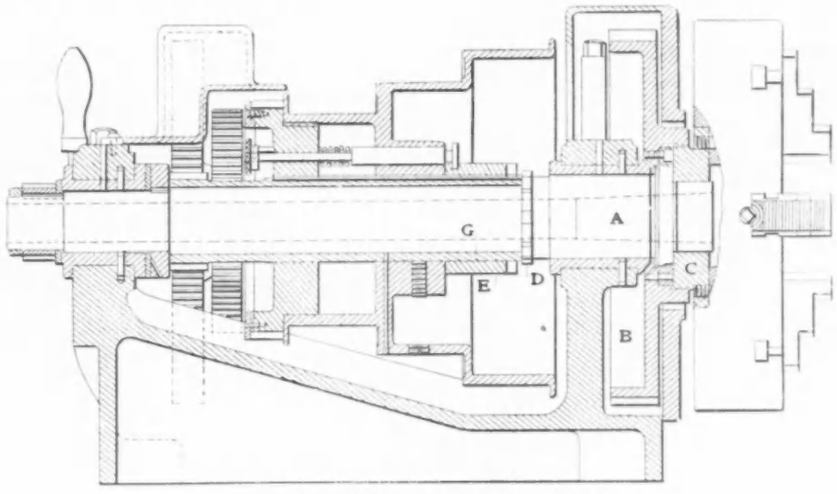


FIG. 2. DETAILS OF THE LATHE HEAD

in place of the lead screw, the object being to preserve the accuracy of the screw and to use it for only accurate chasing. A single wrench operates every adjusting screw throughout the machine, including the tightening of the tailstock to the shears. The cabinet legs have hinged doors with latches operated by knobs.

This is an 18-inch lathe, but the same design is also made in 14- and 16-inch sizes and with plain system of change gears as well as with the quick change, as shown.

The Cold Forging of Machine Bolts

One of the latest developments in the swaging or cold-forging of metal is illustrated in the machine recently built by the E. J. Manville Machine Company, Waterbury, Conn., for making machine bolts by this process. This not only does away with the furnaces and the scale and grit which is very hard on the bearings of machinery used in hot forging, but it is also claimed to make a saving of 20 per cent. in the cost of the bolts made.

In order to have this successful, it was necessary for the steel makers to produce a wire or rod of the right quality so that it will be soft enough to flow into the desired shapes when cold without injury to the fiber and at the same time be sufficiently strong for the bolts when finished. These machines are used in making either square- or hexagon-head machine bolts, or they may be utilized in making lag or coach screws in the same way.

The first machine is known as a double-stroke header which has a feeding device by which the material is taken from a coil, straightened and pushed into the machine the required distance for the blanks. It is then cut off and placed between dies which hold it firmly and at the same time protect that portion which is to form the body of the bolt as at *A*, Fig. 1. The first punch compresses the projecting end into the shape shown at *B*, or any other preparatory shape which is deemed desirable, and the second punch by a very heavy pressure, finishes the head as shown at *C*. On a medium-sized machine sixty-five bolt blanks $\frac{3}{8}$ inch in diameter and $4\frac{1}{2}$ inches long have been made per minute from annealed and

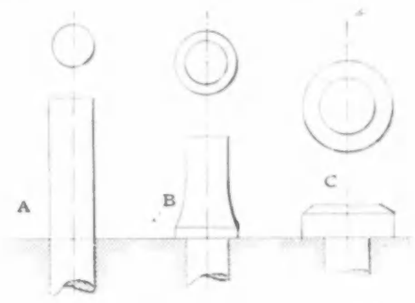


FIG. 1. COLD FORGING OF BOLT HEADS

cleaned wire. This same rate can be maintained on any stock having a tensile strength of about 50,000 pounds per square inch, and an elongation of about 25 per cent.

The next operation is trimming the heads, which is done in the machine shown in Fig. 2. This is horizontal instead of vertical as in the older type, and is entirely automatic so that there is no danger of an operator losing his fingers in feeding it. The blanks are dumped into the hopper and fed as shown in Fig. 3, by an ingenious feed mechanism. The lifter or blade is made of two plates of steel riveted to a distance piece, the lower edge of this being acted on by a crank pin and roller projecting from the face

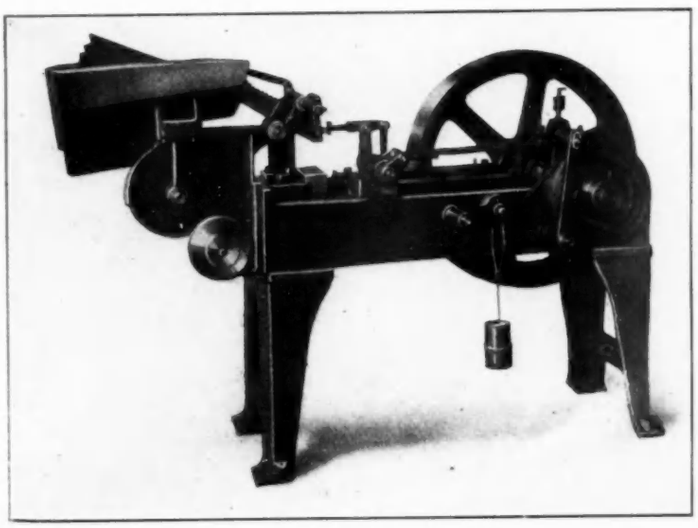


FIG. 2. MACHINE FOR TRIMMING BOLT HEADS

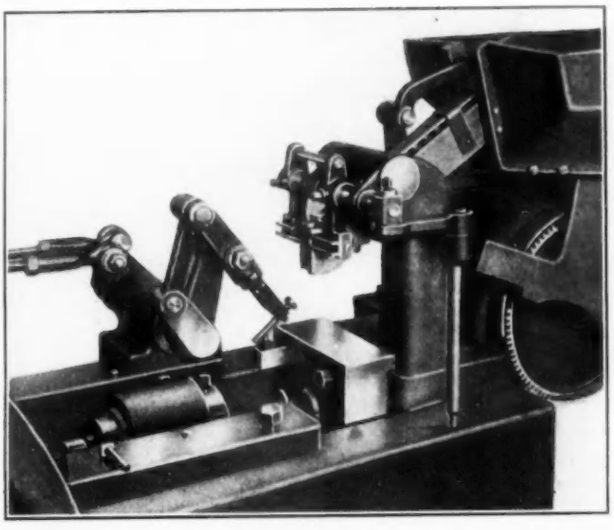
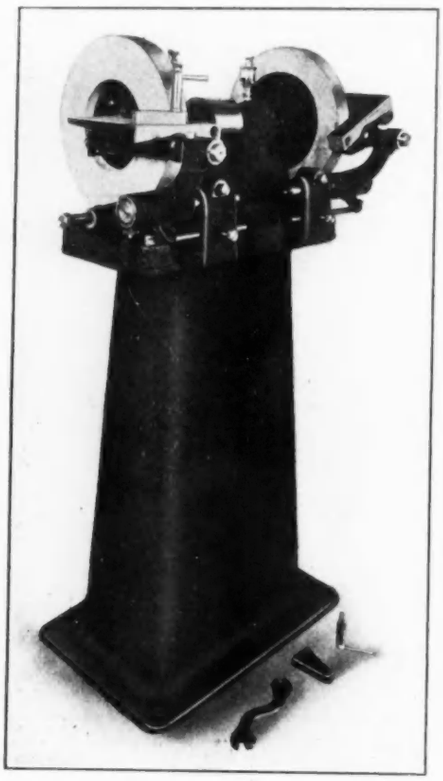


FIG. 3. THE FEEDING MECHANISM

of a plate gear. This forces the two plates up through the blanks which slide down to the feeding fingers in the usual way, a monitor stopping every blank not properly delivered to the fixed track and returning it to the hopper. This machine will trim the blanks before mentioned at the rate of 60 per minute. When the bolt is presented between the punch and die, the punch advances on the body of the blank until it reaches the underside of the head, and its further advance pushed the bolt head against the die and finally into it, shearing it to the required shape. The punch then recedes and leaves the bolt standing out of the die until the gate is on the back end of its stroke, the bolt head then being pushed back out of the die by a knockout pin worked from the gate, and the trimmed bolt falls to the floor.

A Face Grinding Machine

This machine is designed for grinding lathe and planer tools, for edge grinding and squaring up ends of work, and for the general miscellaneous small jobs of grinding in the tool room and in the shop.



FACE GRINDING MACHINE

Recognizing the advantages of keeping wheels in first-class shape provision is made for the use of a diamond in truing up both the face and the periphery of the wheel.

The work table is located in front of and extends past the edge of the wheel, so that both the face and edge of the wheel can be used for grinding. This table is located in a guide carried by a swinging arm, and in the end of the arm a longitudinally adjustable diamond holder is located.

The table can also be moved longitudinally with the machine in the guide and is provided with a threaded hole to receive the diamond holder, which may be transferred to this hole and the edge of the wheel trued.

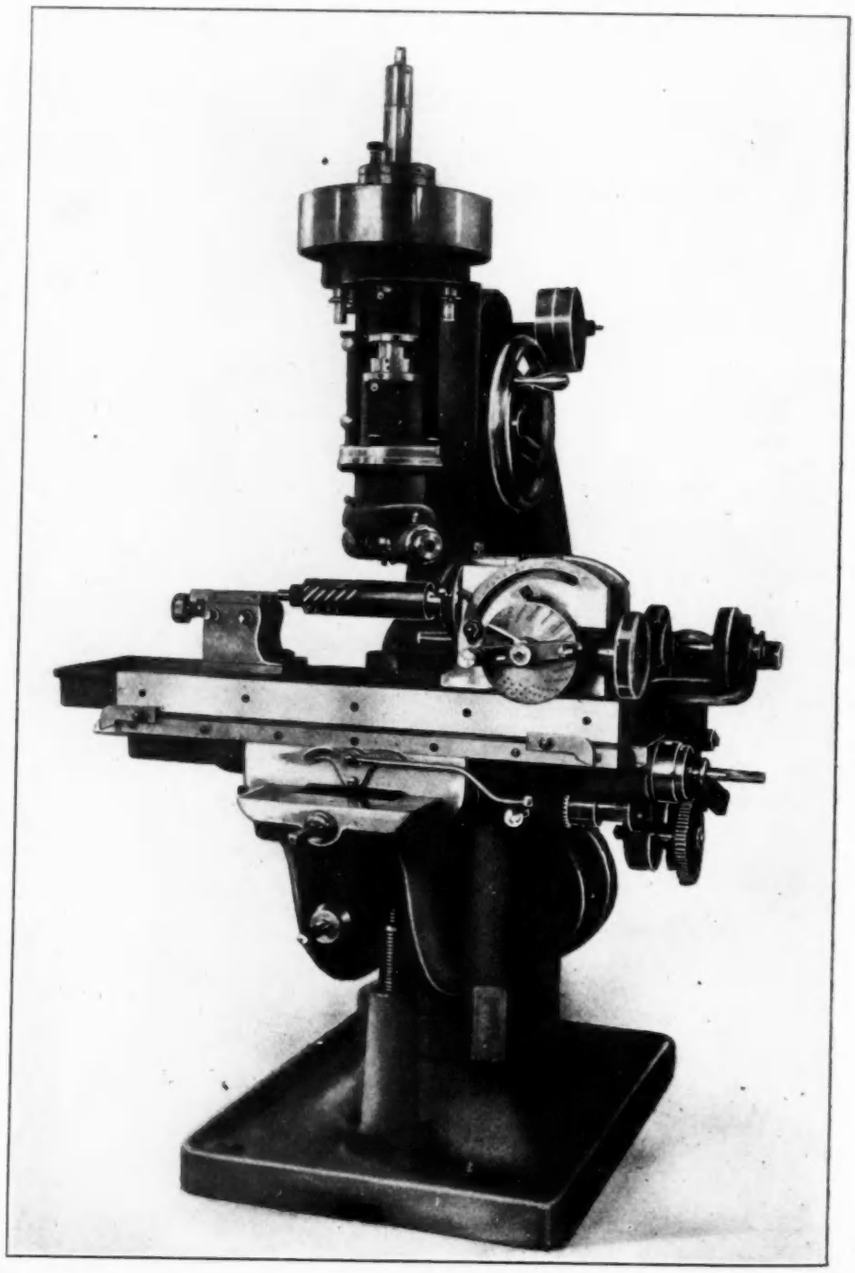
Upon the table is also provided an adjustable squaring device or protractor which may be set from 90 degrees to 45 degrees with the surface of the wheel.

The wheel spindle of this machine is hardened and runs in adjustable bronze boxes. The wheels used are 12 inches in diameter by 1½-inches thick and are recessed. A water tank of ample capacity is provided. This machine is manufactured by the Emmert Manufacturing Company, Waynesboro, Penn.

New Attachments for the Vertical Milling Machine

The Becker Milling Machine Company, Hyde Park, Mass., has just introduced a horizontal attachment which in connection with the new dividing head gives these machines a remarkably wide field of usefulness. This particularly includes the cutting of spirals, hobs, racks, etc., on the same machine that does the heaviest milling work.

The horizontal spindle which is driven by the vertical spindle through the



NEW ATTACHMENTS FOR VERTICAL MILLING MACHINE

medium of bevel gears carries the cutter at a point marking the intersection of the center lines of these spindles. At the point of connection to the sliding head the adjoining surfaces are graduated so that the attachment may be set and clamped at any desired angle to the center line of the platen. This feature makes possible its use on a plain machine for the cutting of spirals, and makes it universal in its scope.

As the cutter is set at the intersecting axes of the two spindles it is evident that the attachment may be revolved horizontally throughout an entire circle. Cuts can therefore be made either lengthwise or crosswise of the platen, or at any intermediate angle. Change of angle may be made instantly without disturbing any other adjustment on the machine. A standard heavy milling machine is by this simple device turned into a universal machine in which no adjustment of the table is necessary, hence the full value of the long platen is secured with its extended support.

The excessive depth of throat in the vertical machine is of special benefit in providing ample space for the working of large pieces in any position on the platen. All of these features have a part in extending the utility of this type of machine. The dividing head used on these machines is of the standard Becker design and construction, driven through a train of gears similar to that employed on the horizontal machines of the same make.

Ball Bearing Chuck

As will be seen in Fig. 1, this chuck is entirely different from the usual construction, the jaws *A* being moved in dovetail grooves across the face of *B*, which is threaded into the central body *G*. The upper edges of the jaws project slightly as can be seen in Fig. 2, and fit

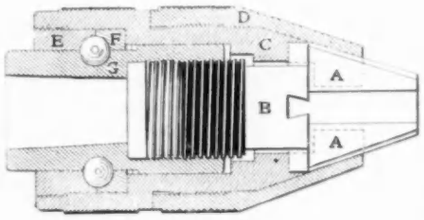


FIG. 1. A BALL-BEARING CHUCK

into recesses in *C*, while the sleeve *D* covers the extended top of the jaw and *C* and *D* together control their movements at all times.

When the chuck body is turned the piece *B* is screwed into or out of *C* and the jaws are moved along the recesses in *C*, and at the same time in and out along the dovetail in the end of *B*. This gives positive control of the jaws in all positions and holds them square with the drill.

The balls between the outer shell and the body *G* are held in position by rings *E* and *F* and make it a very easy matter to operate the chuck. These insure a free movement at all times and the alinement is secured by the plain bearing surfaces toward the front of the chuck. The chuck can be used for holding long drill rods through the chuck itself by removing a plug which is screwed into *D*, though in most cases this will not be necessary. Fig. 2 gives a good idea of a chuck ready to be put together and shows

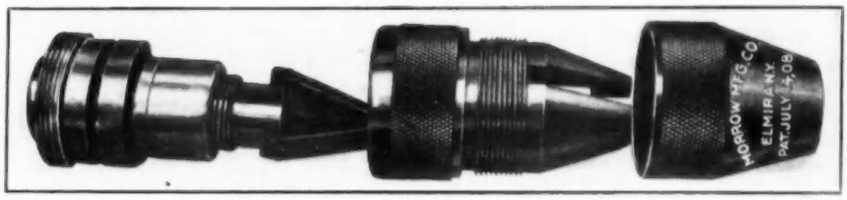


FIG. 2. PARTS OF THE BALL-BEARING CHUCK

the various details of construction. It is made by the Morrow Manufacturing Company, Elmira, N. Y.

Relations of Employer and Employee in Regard to Patents

By Irving D. Kimball

The relations of employer and employee in matters of inventions have become well defined as a result of numerous decisions by the courts. In the endeavor to give to each his just due without infringing upon the rights of the other certain principles have become well established.

The fact that a man is in the employ of another does not in itself give to the employer the ownership in inventions made by the employee, even if they are made with the employer's tools, in his time, and at his expense. To vest the ownership of an employee's inventions in his employer there must be an express agreement between the two that the employee will assign inventions he may make to his employer. The Supreme Court has said that a manufacturing concern which has employed a skilled workman, for a stated compensation, whose duties are partly in devising and making improvements in articles of their manufacture is not entitled to a conveyance of patents obtained for inventions made by such employee while so employed, in the absence of an express agreement to that effect. However, in the case of an invention made by an employee in the time and at the expense of his employer, such employer is entitled to a shop-right or nontransferable license.

In a case coming before the Supreme Court, a concern making plows employed a man to be superintendent of its manufacturing department and also to devise improvements in and perfect plows. He designed a new plow in the company's time, using their materials, tools, and men. The company manufactured the plow, and after several months, during which he made no claim to the ownership of the invention, he left its employ, and later applied and received a patent on the improvements in the plow. The court held that no express contract existed which required him to exercise his inventive faculties for the benefit of his employer, and that all the company could be entitled to was a right to use the inventions in making plows.

It is, however, well established that one who has conceived an invention may employ others to reduce it to practical operation. If in so doing the draftsman or workman makes improvements ancillary to the plan and preconceived design of the inventor, these are considered to belong to the employer and may be included in his patent as a part of his invention. Such instruction to the employee must have been sufficient to enable him, by the aid of his mechanical skill, but without the exercise of the inventive faculty, to construct and put the invention in operation. If the employer merely states that a certain result is desired, without revealing any way of accomplishing such result, and the employee designs a means for accomplishing the result desired, the employee is then the inventor and entitled to the patent. It is not enough that the employer should give a mere hint; on the other hand it is not necessary that he should reveal every minute detail, but he must reveal the substance.

The court in one case put it like this:

"Invention is the work of the brain and not of the hands. If the conception be practically complete, the artisan who gives it reflex and embodiment in a machine is no more the inventor than the tools with which he wrought. Both are instruments in the hands of him who sets them in motion and prescribes the work to be done. Mere mechanical skill can never rise to the sphere of invention. The latter involves higher thought, and brings into activity a different faculty. Their domains are distinct. The line which separates them is sometimes difficult to trace; nevertheless, in the eye of the law, it always subsists. The mechanic may greatly aid the inventor, but he cannot usurp his place. As long as the root of the original conception remains in its completeness, the out-

growth—whatever shape it may take—belongs to him with whom the conception originated."

The reasons for this are simple. A man whose time is very valuable, a superintendent or treasurer of a large concern, for instance, cannot be expected to work out every detail of an invention he may conceive. Then, too, a man may conceive of a plan or arrangement the details of which he may not be as familiar with as a skilled workman in that particular line. What is more natural than that they should hand it over to a skilled workman, or to a draftsman, and let him work out the details. If he improves the design and turns out a neater and more compact article than the employer had in mind, but built upon the original plan of the employer, that is because of his practical knowledge and mechanical skill. It would be ancillary to the employer's invention, and he should be protected from any effort the employee might make to claim his invention.

It is sometimes the case that the employer has the patent applied for in his name without troubling to decide whether he is legally the inventor or not. This is often for personal gratification, and the employee is not usually in a position to make, or desirous of making, any protest. This is a dangerous practice. A patent which, issued to anyone other than the inventor, would be invalid and would be so declared by a court upon sufficient proof. For this reason the question of who is legally the inventor should be thoroughly threshed out in a broad-minded, unbiased manner. In this way it can be decided in whose name the application should be made in order to obtain a valid patent.

Personal*

F. D. MacKay, second vice-president of the E. W. Bliss Company, returned on September 19 from a six week's business trip through England and Scotland.

H. C. Karlson has recently opened an office at 39 Cortlandt street, New York City, as a constructor of automatic and special machinery, and will also engage in soliciting patents.

G. H. Hannum, formerly master mechanic of the Detroit Lubricator Company, has been appointed general superintendent of company's plant to succeed C. P. Harvey, recently resigned.

L. K. Berry, for several years with Warner & Swasey Company, and later with the Wm. Pattison Supply Company, has joined the sales force of the Vandyck Churchill Company's Philadelphia branch.

Thomas H. Allen, formerly with Allis-Chalmers Company, has recently been appointed general manager of the foundry and machine department of the Livermore Foundry and Machine Company, Memphis, Tenn.

F. H. Leland, until recently with Gunn, Richards & Co., has become associated with Warwick, Mitchell & Co., chartered accountants, 79 Wall street, this city. He will continue to devote himself to the introduction of improved methods of shop organization and cost accounting, including the use of the premium plan.

*Items for this column are solicited.

Albert M. Bullard

Albert M. Bullard, an engineer and inventor of considerable prominence, particularly in the field of telephone manufacture, died after an illness of some length September 19. Earlier in his career Mr. Bullard was engaged on important work for the Thomson-Houston Company, and his ability as an inventor brought him in close touch with Prof. Elihu Thomson. Subsequently he was associated with the American Bell Telephone Company and the Western Electric Company.

Business Items

Wm. J. Smith Company, New Haven, Conn., has appointed Fred Ward & Son, Inc., First and Howard streets, San Francisco, Cal., Pacific coast agents for the Smith one-lock adjustable reamers.

The Bay State Screw Company, Springfield, Mass., has recently enlarged and moved into a larger plant at 144 Dwight street, where they are now equipped to do all kinds of special machine screw work to order. A. W. Houghton is the manager.

In order to more properly identify the name of the company with the product, Eberhardt Brothers Machine Company, Newark, N. J., has changed its corporate name to Newark Gear Cutting Machine Company. The personnel of the company remains the same, Henry E. Eberhardt, president; Elmer G. Eberhardt, vice-president; Henry J. Eberhardt, secretary, and Frank E. Eberhardt, treasurer.

Otto Schaum, of the Fay Machine Tool Company, has returned from an extended trip through Europe. While there he made arrangements for the representation of their automatic lathes and tools with C. W. Burton, Griffiths & Co., of London, for Great Britain; R. S. Stokvis & Zohnen, of Rotterdam, for Holland and Belgium; Heinrich Dreyer, of Berlin, for Germany, Austria and Switzerland, and with Edgar Bloxham, of Paris, for France and Italy. Mr. Schaum reports several good sales of his machinery while abroad.

The Grant-Hoover Ball Company has recently been incorporated under the laws of New Jersey, capital $200,000, and has purchased a plant at Merchantville, N. J., covering six acres and fully equipped with ball machines designed by J. J. Grant, of Cleveland, Ohio, its consulting engineer. The two principal members of the new company are Robert H. Grant, formerly superintendent of the Standard Roller Bearing Company, Philadelphia, and L. J. Hoover, superintendent of the ball plant of the same company and also of the Grant Ball Company, formerly of Cleveland, Ohio, and Franklin, Penn. They are prepared to manufacture balls of alloy steel, carbon steel, brass, bronze and cast iron in all the standard sizes up to 2 inches or larger, if required, and will specialize on automobile balls and will have a capacity of 1,000,000 daily.

Trade Catalogs

Graphite Lubricating Company, Bound Brook, N. J. Catalog of graphite and bronze bushings. Illustrated, 5½x9½ inches, paper.

The Baird Machine Company, Oakville, Conn. Bulletin No. 301, describing steam drying barrel. Illustrated, 8 pages, 6x9 inches.

Abenaque Machine Works, Westminster Station, Vt. Catalog of gasolene traction engines. Illustrated, 8 pages, 6x9 inches, paper.

Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin No. 1111, showing application of motors to machine tools. 24 pages, 8x11 inches.

The Rahn-Carpenter Company, Cincinnati, Ohio. Catalog No. 7, describing engine, turret and gap lathes. Illustrated, 40 pages, 9x12 inches, paper.

Windsor Machine Company, Windsor, Vt. Catalog describing automatic turret lathe, multiple spindle and single spindle, piston and ring machine. Illustrated, 24 pages, 6x9 inches, paper.

Edwin Harrington, Son & Co., Inc., Philadelphia, Penn. Catalog F of multiple and radial drills, boring machines, bolt threading and turning machines, etc. Illustrated, 72 pages, 6x9 inches, paper.

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 55 on engine driven generators, Type L. Illustrated, 24 pages, 8x10½ inches. Bulletin No. 56 on Type B belted motors and generators. Illustrated, 4 pages, 8x10½ inches. Leaflets No. 151, 153, showing motor drives for machine tools. Leaflet 152, illustrating ventilating fans. Leaflet 154, illustrating and describing electric emery grinders.

Business Opportunities

The Long Lumber Company, Moselle, Miss., will establish sawmill.

W. S. Dunbar, Rosenberg, Texas, is constructing saw and planing mills.

Mt. Ida Hosiery Mills, Marion, N. C., recently incorporated, will put up building.

The Neenah (Wis.) Paper Company has let contract for a $10,000 addition.

Wm. Volker, Kansas City, Mo., will erect a plant for the manufacture of rubber tires.

The Great Western Stove Company, Leavenworth, Kan., will build a $40,000 foundry.

The Dundee (N. Y.) Brass and Manufacturing Company will erect a new factory building.

It is reported that the Page Boiler Company will enlarge its plant at Meadville, Pa.

The plant of the Roberts Motor Company, of Clyde, Ohio, will be moved to Sandusky.

The plant of the Gribben Lumber Company, St. Paul, Minn., was burned. Loss $95,000.

Fire destroyed the plant of the Lima Insulator Works, Lima, N. Y. Loss about $100,000.

The Chicago Railways Company, Chicago, Ill., will build a car barn at a cost of about $150,000.

The Marshall Electric Company, Boston, Mass., has had plans drawn for a factory at Hyde Park.

The Badger Steel Roofing and Corrugating Company, La Crosse, Wis., will extend its plant.

The Waterbury (Conn.) Clock Company is having plans drawn for an addition to its plant.

Freyer Trunk Manufacturing Company, Houston, Texas, will erect a new three story factory.

The Montgomery (Ala.) Light and Water Power Company will expend $100,000 on improvements.

It is reported that Morris & Marshall, Pell City, Ala., contemplate establishing a shovel factory in Gadsden.

It is reported that the Mechanics' Art School, Boston, Mass., will soon be in the market for machine tools for the new building now going up.

A $12,000 addition will be built at the leather plant of George Stengel, Inc., Newark, N. J. This will be used as a tannery and shaving room.

George H. Tennant, Minneapolis, Minn., manufacturing hardwood and parquet flooring, is erecting a new building to replace one recently burned.

The W. S. Tyler Company, Cleveland, Ohio, has awarded contract for a new four-story factory. The company manufactures ornamental ironwork, etc.

The American Metal Stamping Company has been organized at Worcester, Mass., to manufacture stamped metal specialties. Office is 43 Pleasant street.

Bids are asked until 3 p.m. October 19 by the Water Department, Houston, Texas, for the installation of a 15,000,000-gallon pumping engine at the water plant.

The Bourbon Marble Works is erecting a plant at Paris, Ky. A 15-ton and 6-ton traveling crane will be installed, also air compressor to operate pneumatic tools.

The National Sanitary Manufacturing Company, Salem, Ohio, has about completed the erection of its new plant, which consists of a foundry and enameling building.

The Ramey Manufacturing Company, of Butler, Ohio, will move to Newark, where a new plant will be erected for the manufacture of its furnaces, sawmills and blowers.

Plans for the new terminal of the Public Service Corporation of New Jersey at Hoboken are completed. The company has offices in the Prudential building, Newark, N. J.

It is reported that the International & Great Northern Railroad will probably rebuild the burned shops at Taylor, Tex. O. H. Crittenden, Palestine, Texas, is chief engineer.

The Tampa (Fla.) Northern Railway has plans completed and contemplates commencing construction of railway repair shops at Palmetto Beach. John Pasco, Tampa, chief engineer.

The La May Machine Works, Rochester, N. Y., has purchased site on which to erect plant for the manufacture of special machinery. It is said about 1000 men will be employed eventually.

The Pacific Tank Company, Los Angeles, Cal., will erect a plant at Alameda. This is to include a rolling mill to be operated in connection with a department for turning out metal tanks for oil.

The Chicago, Rock Island & Pacific Railway Company will spend $100,000 in terminal improvements at Fort Worth, including a new roundhouse. J. B. Berry, Chicago, chief engineer.

D. G. & H. B. Davis, East Liverpool, Ohio, are said to be promoting the establishment of a factory for manufacturing brass and special valves, which, with equipment, will cost about $50,000.

The Connecticut Iron, Steel and Metals Company has been incorporated at Bridgeport, Conn., and is contemplating the erection of a factory. Incorporators, L. M. Petrucelli, L. E. Richards and others.

The F. W. Graham Manufacturing Company, Racine, Wis., is erecting a new building to be fitted up with modern machinery. The company makes wood and metal patterns and also build special machinery.

G. W. Morris, formerly general superintendent of the J. I. Case Threshing Machine Company, has purchased a site for the erection of a large and modern factory at Corliss, Wis., for the manufacture of traction engines.

It is reported that the Norfolk & Southern Railway will enlarge its shops in Berkley, Va., and Newbern, N. C., and make other improvements, expending about $1,000,000. Thomas Fitzgerald, Norfolk, Va., general manager.

A factory will shortly be erected for the Automatic Measuring Faucet Manufacturing Company, Seattle, Wash., recently incorporated under the laws of the State of Washington with $50,000 capital. A. C. Foohlich, president.

The Des Moines, Council Bluffs & Western Railway Company has been incorporated with a capital of $100,000 to build a road from Council Bluffs to Des Moines and there to Muscatine. R. C. Wallace, J. S. Carlock, R. S. Bannister, Des Moines, are among the directors.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Test indicators. H. A. Lowe, Cleveland, O.

Caliper list free. E. G. Smith Co., Columbia, Pa.

High speed machinery designed. Fred. L Fay, Wilmington, Del.

Small, accurate drill jigs and dies built to order. R. Rosner, Madison, Wis.

Make an A-1 indicator. Blueprint, 25 cents. D. Tappan, Watervliet, N. Y.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Orders for brass goods. Castings and finished product. Box 486, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

For any machine or small tool firms not yet represented in France please apply to "Société Francaise de Machines-Outils, 3, Rue Arsène Houssaye à Paris."

Is there a shop that wants to manufacture and control, a much sought unit for marine and municipal purposes. Address "Old Super," AMERICAN MACHINIST.

Wanted—A second hand grinder for automobile engine cylinders. Give full description of machine, how long in use, and price. Box 503, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Lathe and machine work of every description, patterns, gear cutting, screw machine work, iron, brass and aluminum castings. The Sipp Electric and Machine Co., Paterson, N. J.

Wanted—Articles to manufacture by contract or will buy patent, tools and fixtures outright, by a manufacturer having a large and well equipped plant and capital. Address Box 564, Erie, Pa.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Streets, New York City.

Wanted—To correspond with molders and machinists who would like to go into business for themselves on the co-operative plan. Shop in Michigan. Good opening for steady men with some means. Address "Co-Operative Co.," Box 502, AMERICAN MACHINIST.

Patent & Designs Act, 1907—A leading firm of machine tool makers are prepared to undertake the manufacture for patentees of any suitable articles (preferably machine tools), which must be made in Great Britain under the provisions of the above act. Apply Box 474, AMERICAN MACHINIST.

Wanted—Patented article that can be used in machine shop boiler room, or engine room. Must have merit. We possess finest facilities for marketing, having a large force of traveling men in this country, and agents in nearly every large city in Europe, who call upon steam users and machine shops. Liberal contract. Highest of references. Address Diamond Power Specialty Co., 236 Fort St., W., Detroit, Mich.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

INDIANA

General foreman for machine shop, experienced on gas and steam engines, machine tools, mill maintenance and automobile work; good executive, up-to-date, technical. Address "R. S. C.," 1324 W. 30th St., Indianapolis, Ind.

MASSACHUSETTS

A toolmaker on jig, fixture and special tools for the rapid production of duplicate parts. Desires change; could take charge of small department. Box 481, AMERICAN MACHINIST.

MISSOURI

Wanted—Position as tool foreman, assistant superintendent or mechanical engineer by technical man, 31, experienced as machinist, tool designer and foreman. Box 500, AMER. MACH.

NEW JERSEY

Mechanical engineer, eight years designing and erecting power plants, shop, drafting, experience executive ability. Box 483, AM. MA.

Position as toolroom foreman, master mechanic or assistant superintendent by first class mechanic used to fine interchangeable machinery and tools. Address Box 858, Orange, N. J.

NEW YORK

A superintendent or manager; good mechanic and executive. Box 511, AMERICAN MACH.

Draftsman, expert mechanical, desires New York City situation. Box 514, AMER. MACH.

Experienced designer and draftsman. Printing and automatic machinery a specialty. Best of references. Box 510, AMER. MACH.

A superintendent having charge of 100 mechanics desires change for good reasons; proposals will be considered. Box 501, AMER. MACH.

Competent, capable mechanical draftsman with five years' experience along general lines. Technical graduate, accurate, quick worker, desires change at $18.00 to start. Box 513, AMERICAN MACHINIST.

Master mechanic, age 40, technical graduate, 18 years' practical experience designing and constructing dies, fixtures and special automatic machinery. Desires permanent position. Box 498, AMERICAN MACHINIST.

Draftsman, with 14 years' shop and office experience, locomotive design, special work, systematic rearrangement of equipment in machine, boiler shops, etc., to reduce unapplied labor and increase output. Box 506, AM. MA.

Master mechanic with extensive and varied experience constructing and manufacturing in the States, Canada and South America, age 39, desires position where a responsible, high grade, broad gauge man is wanted. Box 507, AMERICAN MACHINIST.

Machine and tool foreman will be open for engagement November 1. Expert machinist, tool and diemaker; designer of tools, dies, jigs, fixtures for economical production of duplicate machine parts or articles of metal at minimum cost. Box 497, AMER. MACH.

Mechanical engineer, Stevens (29), Jun. A. S. M. E. Five years' experience in shop work, mill construction, designing special machinery and piping layouts for power plants. Desires suitable position in the East. Address "Factory Engineer," care AMERICAN MACHINIST.

Mechanical engineer is open for engagement as superintendent, master mechanic or general foreman; technical education; large experience as designer and manufacturer of interchangeable machinery, sheet metal goods, electric instruments, typewriters, etc. Box 491, AMERICAN MACHINIST.

Draftsman—Mechanical and designer, technical graduate. Eleven years' experience (two shop and nine office). Marine and land engineering, textile machinery, power transmission, mill construction and laying out machinery, etc. Anxious to secure situation; can give excellent references. Box 509, AMER. MACH.

OHIO

Pattern foreman, experienced in all departments, good executive, wants position as assistant superintendent or foreman. References. Box 504, AMERICAN MACHINIST.

Age 45, married; wide shop, drawing room and office experience; best shops, toolmaking, machine tool building, light cars, small gasolene engines and miscellaneous. Past 18 years in charge. Superintendent or other responsible position. Address "Yankee," care AMERICAN MACHINIST.

PENNSYLVANIA

Want position as foreman in machine shop. Fifteen years' experience as machinist and draftsman and am good with figures. Box 495, AMERICAN MACHINIST.

Expert cost accountant and systematizer desires an executive connection with manufacturing concern. Up-to-date methods and satisfactory results guaranteed. Box 304, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Agents wanted for Canada to represent first-class machine tool firm. Please apply to Société Francaise de Machines-Outils, 3, Rue Arsène-Houssaye, a Paris.

Wanted—Superintendent for a Canadian factory. Company has large government contracts and up-to-date plant. Applicant should be all round machinist and draftsman, familiar with small interchangeable work, having thorough knowledge of punch press work. Large salary to right man. State age, experience and salary wanted, give references, address direct. Sutherland Rifle Sight Co., New Glasgow, N. S., Canada.

CONNECTICUT

First class bolt and screw header operator wanted for continuous work on a Standard No. 4 header. Young man with executive ability preferred, as opportunity for advancement to position of foremen will be open. Wages $2.50 per day while operating header. State age, experience and references. Post Office Box 287, Hartford, Conn.

ILLINOIS

Wanted—Working foreman to take charge six to ten toolmakers. Permanent position. State experience and wages. Box 512, AM. MA.

INDIANA

A patternmaker for gasolene engine work, good wages. Box 484, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—A draftsman, one who is well up in modern methods. Must be a man of ideas and capable of designing automatic machinery to reduce cost of manufacture. Whoever secures this position must prove to us his ability by references or otherwise. Please give full information, including age and salary expected. Factory near Boston. To the right man this position is permanent. Answers to this ad. will be held strictly confidential. Box 505, AMERICAN MACHINISTS.

NEW YORK

Wanted—A young man, expert in making time study for setting piecework rates. Must have tact and mechanical ability. The opportunity offered for making good is an excellent one for the right man. State age and experience. Address "Opportunity," P. O. Box 16486, New York.

Wanted—Mechanical engineer and salesman, with shop experience preferred. Must be familiar with special machinery designing, and competent to estimate on work and follow up new business when required. Opportunity with future for right man. Address with full particulars as to experience, age, nationality, references and salary expected to start. Box 515, AMERICAN MACHINIST.

Wanted—Superintendent experienced in manufacture of automatic and special machinery. Must be first class mechanic and executive, familiar with modern shop methods. Progressive man with push and ability will find this unusual opportunity with rapidly growing business. Give full particulars stating age, experience, references and salary expected to start. Box 516, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—At once, a few mill and structural draftsmen. Technical men preferred. In replying, state compensation expected and earliest date available. Box 496, AMERICAN MACHINIST.

Draftsman—Small but growing Philadelphia firm wishes a thoroughly experienced party for designing, drawing, stamping and forming dies. State salary expected, age and past experience. Box 499, AMERICAN MACHINIST.

Mechanical engineer wanted in an iron foundry and manufacturing plant to take general charge of the machinery, buildings and power; one having some previous experience in the valve business or kindred lines preferred. Replies must state experience fully and will be treated confidentially; give age, salary expected, etc. Box 489, AMERICAN MACHINIST.

FOREIGN

Required specialist for Russia (Baltic provinces) to make the installation and to survey the manufacturing of enameled cast-iron tanks and other enameled cast-iron articles; also utensils for water conducting. Address letters to: Sub-Lit. R.S.M., care L. & E. Metzl & Co., Morskaja 11., St. Petersburg, Russia.

For Sale

Classification indicates present address of advertiser, nothing else.

For Sale—Power grindstone frame for 4"x30" stone. Rose Polytechnic Shops, Terre Haute, Ind.

For Sale or Rent—Foundry, machine and wood shops with machinery in town of 5000. Box 227, Bergen, N. Y.

For Sale—Ten complete jewel-makers' lathes; also wigwags and parts for both. Price of lot to settle estate $75.00 or $8.00 each, regular price $12.50. Send for circular. Address Estate of Arthur L. Hill, Waltham, Mass.

For Sale—The complete outfit for manufacturing the best granulated and plastic metallic packing in the world for steam, air and ammonia. Established 12 years. No experience required. Just the thing in connection with a machine shop. Address P. O. Box 24, South Stillwater, Minn.

Auction sale of all the machinery, tools, etc., of the Fishkill Boiler Works, Fishkill Landing, N. Y., consisting of set boiler rolls 9'x6', Allens double belt riveting machine, Hillis & Jones 16' plate plate planer, 6' set boiler rolls, heavy double end boilermakers' punch and shear, 48", made by Kent; and a large lot of shafting, pulleys, small boilermakers' tools and new supplies on Wednesday, October 7, 1908, at 11:30 a.m. Catalogs with full lists sent on application to R. W. Doughty, P. O. Box 794, Fishkill-on-Hudson, N. Y.

For Sale—Tracings, patterns, jigs and templets for the following size gas and gasolene engines: 1½, 3 and 5 horse-power vertical and 3, 5, 8, 10, 12, 16 and 20 horse-power horizontal; also a number of finished and unfinished engines of the above sizes. All of the above sizes have been in successful operation for several years. This is a splendid opportunity for anyone wishing to build gas or gasolene engines. You can save thousands of dollars in experimental work by purchasing this complete outfit. Shop rights of valuable patents on these engines will be given to purchaser. Box 366, AMERICAN MACHINIST.

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